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The Effects of Narrowband and Wideband Public Safety Mobile Systems Operation (in television channels 63/68) on DTV and NTSC Broadcasting in TV Channels 60-69 (746 MHz - 806 MHz)

Final Report

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CRC Report No. CRC-RP-2003-001
Ottawa, 31 March 2003

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Canada

CRC

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Executive Summary

Scope

As part of the development of spectrum policy proposals to designate a modest portion of spectrum for mobile services such as Public Safety (PS) in television broadcasting channels 63 and 68, Industry Canada required an assessment of the interference potential between Broadcasting and Mobile services. The goal of this study is to assess the impact of PS communications on the performance of both analog and digital television broadcasting in TV channels adjacent to 63/68 specifically in order to allow the co-existence of broadcasting and public safety services. While Industry Canada has indicated that only television channels 63/68 will be designated for public safety use in the near term, we have also provided the co-channel results of our assessment that may be relevant in the longer term. I.e. when the transition from analog to digital television broadcasting has been completed.

Background

The results of the assessment would allow Industry Canada to establish the appropriate interference protection criteria in order to enable the two services to share adjacent spectrum and co-exist on an interference-free basis. This assessment could also assist the Department in determining the means and conditions under which public safety services could use a modest amount of spectrum in these channels without negatively impacting the roll out of digital television in Canada.

To study the impact of PS interference into analog National Television Standards Committee (NTSC) and Digital Television (DTV) channels adjacent to channels 63/68, Industry Canada's contracted the Communications Research Center (CRC). Also, CRC carried out testing on sharing the spectrum between the two services on a co-channel basis.

Methodology

The technical parameters used by the CRC study relating to transmitter power, emission limits, spectrum efficiency, channel bandwidth and the number of required PS channels, were obtained from Canadian Sources and from FCC documentation.

From the parameters obtained, a test plan was developed to evaluate the effects of interference from single and multi-channel PS channel transmitters on the performance of NTSC and DTV broadcasting.

The single channel tests were done to determine the effects of the interference created by a single channel (narrowband and wideband) PS transmitter in channels 63/68 into adjacent channel DTV or NTSC transmission. The Multi channel tests were done to determine the effects of a typical combination of some narrowband and wideband PS transmissions in channel 63/68 into adjacent DTV or NTSC channels. The multi channel tests were also done to determine the need for a guard band between the PS and the TV channels.

As no PS equipment was available, CRC used an Arbitrary Function Generator (AFG) to create the test signals. These PS test signals were used to determine the Desired to Undesired (D/U) ratios for the DTV and NTSC TV signals against PS interference at the Threshold Of Visibility (TOV) for DTV and at a level defined by the ITU-R3 (grade 3 – video or audio slightly annoying) for NTSC.

Findings

PS Single Channel Test Results.

The purpose of the single channel tests is to determine the effect of the interference created by a single narrowband or wideband PS channel transmitting into DTV or NTSC services on a co-channel or adjacent channel basis. The single channel test results show the following:

- Co-channel PS single channel Interference into DTV

1. Under co-channel conditions, a D/U of at least 15 dB is required in general for DTV threshold performance over most of the channel bandwidth. However, placing PS channels in the vicinity of the DTV pilot and modulation carrier frequency (around PS channel 480) will require about 5 dB more protection.

2. About 6 to 10 dB less protection is required if the PS channels are placed within the DTV receiver's notch filter bandwidth[1].

- Adjacent channel PS single channel Interference into DTV

For Adjacent Channel Interference, the results show that a modest amount of upper and lower guard[2] band would provide enough protection at the grade B equivalent contour of a DTV station if the transmitters were co located[3].

- For the upper adjacent PS channel about 200 kHz of guard band taken inside PS channels 63/68 would provide a D/U better than –20 dB in the DTV.
- For the lower adjacent channel, about twice as much guard band may be required.

- Co-channel PS single channel Interference into NTSC

[1] It is noteworthy that not all DTV receivers have notch filters implemented, as this is not mandatory in the specifications. Also, it is expected that this filter will not be implemented anymore once the NTSC system is turned down.

[2] This guard band is assumed to be removed from the PS channel bandwidth (inside channels 63 and 68), so that adjacent TV channels are not affected.

[3] Co located means a PS transmitter at the same location of the TV transmitter or with in a radius of up to 8 km from the TV transmitter.

Single channel results for NTSC show the requirement for a D/U of about 50 dB for good NTSC performance. A few dB of additional protection will be needed around the NTSC visual, chroma and audio carriers.

- Adjacent channel PS single channel Interference into NTSC

  For Adjacent Channel Interference, the results show that around 200 kHz of upper and lower guard band would allow for a D/U better than 0 dB into the NTSC channel. This would provide enough protection at the grade B equivalent contour of a NTSC station if the transmitters were co located[3].

PS Multi Channel Test Results.

The purpose of the multi channel test is to determine the effects of a typical combination of narrowband and wideband PS channels transmitting into DTV or NTSC services on a co-channel or adjacent channel basis into DTV and NTSC.

- Co-channel PS multi channel Interference into DTV and
  Adjacent channel PS multi channel Interference into DTV.

  The D/U requirement is similar to a DTV co-channel interferer, for co-channel PS signals and DTV adjacent channel interferer, for adjacent channel PS signals when 22 to 24[4] PS channels are used i.e. PS can be treated as an equivalent DTV signal.

- Co-channel PS multi channel Interference into NTSC

  The D/U requirement is similar to a DTV co-channel interferer when 22 to 24 PS channels are used i.e. PS can be treated as an equivalent DTV signal.

- Adjacent channel PS multi channel Interference into NTSC

1. For lower adjacent channel, the D/U requirement is similar to a DTV adjacent channel interferer when 22 to 24 PS channels are used i.e. PS can be treated as an equivalent DTV signal.

2. For the upper adjacent channel, in some cases, PS was up to 5 dB worse than an equivalent DTV signal. This is because, in this case, the PS signal is close to the NTSC video carrier, and the NTSC signal sensitivity to the interference is frequency dependent.

In the case of interference to NTSC, it should be mentioned that the NTSC threshold is rather softly defined. The threshold was defined as an ITU Grade 3 picture (slightly annoying). Even a value of 5 dB below the adjacent channel threshold will not cause a signal drop out, but only a

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[4] These are the maximum numbers of narrowband and wideband channels combinations allowed under practical implementation scenario for any one combiner. For a lessor number of channels, a correction factor will have to be applied to the current results.

loss of around 0.5 ITU grade. Therefore, in the case of multi channel systems, for planning purposes, the PS multi carrier system may be treated as a DTV system since, within the margin of experimental error, the DTV Canadian planning parameters are either met or exceeded by the multi channel PS results.

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Abbreviations

ACCP	Adjacent Channel Coupled Power
ACI	Adjacent Channel Interference
AFG	Arbitrary Function Generator
ANSI	American National Standards Institute
CCI	Co-Channel Interference
CMRS	Commercial Mobile Radio Service
CQPSK	Compatible Differential Offset Quadrature Phase Shift Keying
CRC	Communications Research Center
D/U	Desired signal to Undesired Signal Ratio
DTV	Digital Television
EIA	Electronic Industry Association
ERP	Effective Radiated Power
FCC	Federal Communication Commission
HAAT	Height above Average Terrain
IC	Industry Canada
ITU-R3	Analog TV threshold of Visibility - Slightly Annoying
NB	Narrowband
NTSC	National Television Standards Committee
PS	Public Safety
QAM	Quadrature Amplitude Modulation
SITT	Spectrum, Information Technology and Telecommunications
TIA	Telecommunications Industry Association
TOV	Threshold of Visibility
UMTS	Universal Mobile Telecommunications System
WB	Wideband

Scope

This report commissioned under an Industry Canada SITT contract studies the impact that co-channel interference (CCI) and adjacent-channel interference (ACI), produced by public safety (PS) mobile system operation in channel 63/68, has on DTV and NTSC operating in and around channels 63/68. Since the study is done on the basis of a Desired to Undesired signal ratio (D/U) the results obtained from the tests conducted in channel 63 may be applied to channel 68 also. By extension, the test results may be applied to TV channels 64 and 69.

Introduction

The demand for new public safety spectrum in Canada has resulted in the release of an IC spectrum policy proposal document seeking to introduce that mobile service and allowing it to operate on a co-primary basis with the broadcasting service in the frequency band 746-806 MHz (Television Broadcasting Channels 60-69)[5]. Currently this spectrum is used by TV stations for NTSC broadcast and has also been assigned to DTV TV stations for future use. Taking into account the DTV transition, IC will subsequently seek to identify a modest amount of spectrum in the 700 MHz band for public safety and possibly for commercial mobile services. It is expected that TV channels 63 and 68 will be least impacted by the Transition Allotment Plan and therefore, designated for the public safety mobile service.

Until the transition to DTV is completed, there are both Co-Channel Interference (CCI) and Adjacent Channel Interference (ACI) cases that will exist for DTV and NTSC that must be investigated to ensure co-existence of both services. These cases exist in TV channels 63 and 68 at and beyond the region of the Canada/US border. ACI and CCI will also exist in TV Channels 64 and 69 related to public safety operations and in the remaining TV channels between 60 and 69 related to other commercial mobile radio operations in the US, however, for both cases only near the Canada/US border.

[5] Notice No. DGTP-004-01 — Proposal to Introduce the Mobile Service on a Co-primary Basis with the Broadcasting Service in the Frequency Band 746-806 MHz

In order to provide the basis for which the test plan and methodology is derived, Section 1 provides the background of the environment from which parameters required to conduct the tests must be extracted considering both the Canada and the US system implementation scenarios.

Section 2 looks at the current plan for DTV use of channels between 60 and 69 in Canada thus providing input as to how the environment for TV operation in this band will change with the introduction of PS mobile systems. The test plan will take these changes into account.

Section 3 presents the NTSC/DTV protection criteria proposed by the US for use in the interim period against which the test results may be compared.

Section 4 presents the US rules on their PS operations in the vicinity of the Canadian border. This provides input regarding sources of interference in the Canadian border region which need to be accounted for in the tests.

Section 5 provides the relevant parameters such as modulation, spectrum efficiency, emission limits etc. used as input to the test process.

Section 6 presents the results of the test followed by conclusions and recommendations in

Section 7 and 8 respectively.

Appendix I present's the terms of reference provided by Industry Canada for the study.

Appendix II presents the FCC Emission Limit Verification Test Procedures.

Appendix III provides Background Information relevant to the Development of the Test Plan.

Appendix IV presents the Test Plan details.

Finally, appendix V shows the test results for both single and multi-channel tests in a tabular form.

1 Background

The expected vacation of TV channels 63 and 68 for public safety (PS) use in Canada must be viewed in the contexts of the changes to the upper 700 MHz band (746 MHz-806 MHz) in the US. In the United States the UHF spectrum from TV channel 60 and up to channel 69 has been set aside for the use of wireless services[6]. Presently television stations both in Canada and the US occupy this band. Broadcasters in the US are required to return their analog spectrum in this band by end of 2006, or when the penetration rate for digital TV reaches 85%. After that time, this upper 700MHz band will then be dedicated totally to new digital wireless services.

Table 1.1 – Commercial Mobile Radio Service Spectrum, Upper 700 MHz Block

Block	Frequencies (MHz)	Bandwidth	Pairing
A (Guard Band)	746- 747, 776- 777	2 MHz	2 x 1 MHz
B (Guard Band)	762- 764, 792- 794	4 MHz	2 x 2 MHz
C	747- 752, 777- 782	10 MHz	2 x 5 MHz
D	752- 762, 782- 792	20 MHz	2 x 10 MHz

The US has identified spectrum in the upper 700 MHz band for Commercial Mobile Radio Services (CMRS) and for public safety (PS). The CMRS spectrum shown in Table 1.1 will be auctioned. This spectrum is also illustrated in figure 1.1.

The section of the band designated for PS i.e. the 24 MHz paired as 2 x 12 MHz occupying spectrum from 764 MHz to 776 MHz and 794 MHz to 806 MHz have been excluded from the

[6] WT Docket No. 96-86 The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Agency Communication Requirements through the Year 2010 and WT Docket No. 99-168 Service Rules for the 746-764 MHz and 776-794 MHz Bands and Revisions to Part 27 of the Commission's Rules

auction process. This spectrum has been earmarked for new digital narrowband and digital wideband services for public safety.

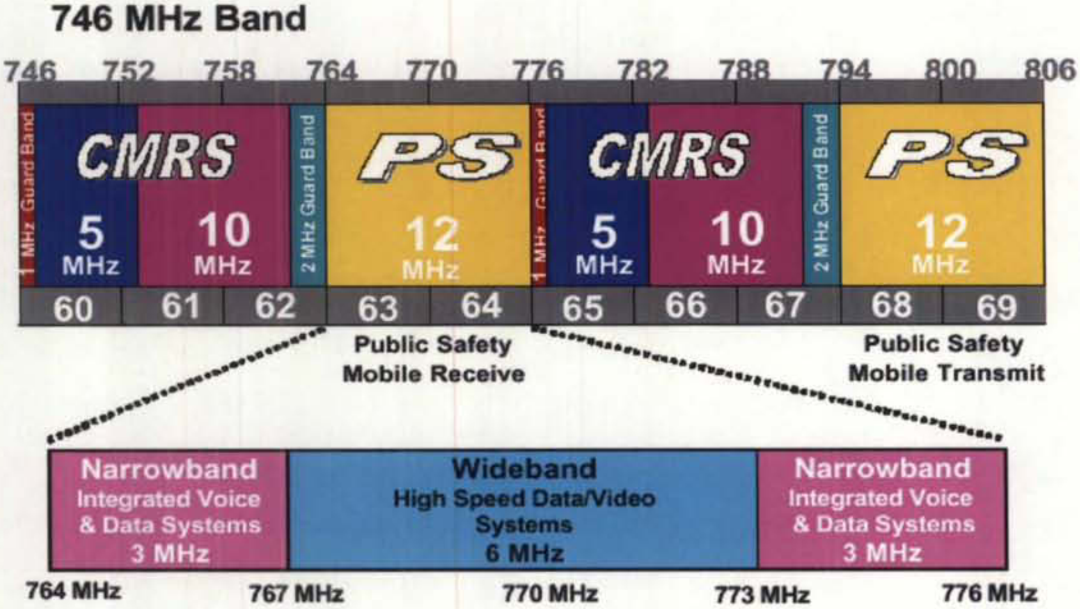


Figure 1.1 – US National Band Plan for Digital Wireless Services in 700 MHz Band

Figure 1.1 shows the partitioning of this block between guard band, CMRS and PS. The upper 12 MHz of PS spectrum (794 MHz to 806 MHz - TV Channels 68/69) has been assigned for mobile Transmits (Tx) and base station Receive (Rx). Also, the lower 12 MHz (764 MHz to 776 MHz – TV Channels 63 and 64) for base station Tx and mobile Rx. Mobiles are also allowed to transmit in this band during a talk around scenario.

This public safety spectrum is currently used for TV channels 63 and 64 and 68 and 69 and has also been assigned to DTV use in Canada. Canada will likely use TV channel pair 63/68 for public safety. Since Canada has already allocated some channels in this band for the use of DTV particularly in the congested metropolitan areas, which in some cases are in close proximity to the US border, it has become necessary to study the effects of the associated interference.

Of interest are the interference effects of a PS mobile system on DTV or NTSC channels operating in and/or around the designated public safety band (TV Channels 63-64/68-69). These radios include base station transmitters, fixed transmitters, control stations, portable radio, and mobile radios.

2 Canadian DTV Operation in the 700 MHz band

Channels between 60 and 69 have all been allotted for DTV in the allotment plan. All are also currently assigned to NTSC stations in various regions in Canada. Currently under consideration by Industry Canada is the vacation of only channels 63 and 68 in support of PS. Thus, channels 64 and 69 will still be allowed to broadcast TV in Canada contrary to the US use. In this operational environment, various adjacent channel and co-channel interference scenarios between mobile radio operating in the lower PS band and TV channels 63 and 64 need to be studied. The results of such a study would apply equally to channels 68 and 69 in the upper PS band although mobile transmitter powers are lower on these channels. This is because the results of the study will be expressed as a Desired to Undesired (D/U) power ratio as opposed to absolute power values. This study by CRC commissioned by Industry Canada (SITT) should provide valuable input about the NTSC or DTV performance in the presence of the PS mobile systems.

The DTV allotment plan show the broadcast undertakings for the use of channels 60 to 69 during the transition phase from NTSC to DTV. This plan considers both low power and regular power stations. A study of the plan focussed on the final DTV assignments in this band, both low and regular power, and do not factor in the current NTSC assignments between channels 60 to 69. It was found that most of the assignments are to low power stations. The plan also shows that there are a total of 25 DTV assignments to channel 63, 41 DTV assignments to channel 68, 56 DTV assignments to channel 64 and 37 DTV assignments to channel 69. The normal power stations were found mostly in the major metropolitan areas which are usually close to the area most of concern, the US border. Thus in the interim, 66 DTV stations operating on channels 63/68 most of them being low power stations will have to be protected from harmful interference from the PS transmitters. There may be a similar number of NTSC stations requiring protection also, during the interim period.

3 NTSC / DTV Protection.

In the US, protection for NTSC and DTV television operation in the PS band is required until the DTV transition is completed (December 31, 2006 or when penetration rate for DTV reaches 85%)[7]. This allows time for operators to convert to DTV and vacate the band.

Protection for both NTSC and DTV is based on separation distances between land mobile radio sites and NTSC / DTV transmitters. The separation distances are calculated such that for a broadcasting NTSC TV station a D/U signal ratio of 40 dB or greater is obtained at the grade B contour for CCI and a D/U ratio of 0 dB is obtained for ACI at the same contour. For the case of a DTV station a D/U of 17 dB for CCI and – 23 dB for ACI or better must be maintained at the station's equivalent grade B contour.

Table A3.1 in Appendix 3 provides a summary of the requirements. Public Safety systems may have to either increase their separation distance or reduce their power and emission limits in order to meet these requirements until 2006 after which time they will be guided only by power and emission limits. Canada may need to develop a similar set of rules for channels 63 and 68 during the transition period. The results of the tests should assist this process.

4 Canada / US Border Region.

Regarding the licensing of US PS systems in the 700 MHz band near the Canadian border, the FCC takes the following approach:

"In examining this issue, the Commission typically takes one of two approaches. We either postpone licensing of land mobile stations within a certain geographic distance (e.g., 120-km (75 miles)) of Canada and Mexico, or permit interim authorizations conditioned on the outcome of future agreements. Because international negotiations can take many months or even years to finalize, we wish to take the later approach and adopt certain interim requirements for public

[7] Public safety base, control, and mobile transmitters in the 764-776 MHz and 794-806 MHz frequency bands must be operated in accordance with the FCC rules of §90.545 to reduce the potential for interference to public reception of the signals of existing TV and DTV broadcast stations transmitting on TV Channels 62, 63, 64, 65, 67, 68, 69.

safety licenses along the Canada and Mexico borders, providing that the licenses are subject to whatever future agreements the United States develops with the two countries. Nevertheless, existing mutual agreements with Canada and Mexico for the use of these bands for UHF television must be recognized until further negotiations are completed. Additionally, public safety facilities within the United States must accept interference from authorized channel 60-69 TV transmitters in Canada and Mexico in accordance with the existing agreements. Since the locations of the Canadian and Mexican assignments are known for UHF television, the public safety applicants can consider the levels of harmful interference to expect from Canadian and Mexican UHF TV stations when applying for a license. Both Canada and Mexico have been informally notified that the Commission has changed its allocated use of TV channels 60-69, and the Commission will discuss the possibility of mutually compatible spectrum use with Canada and Mexico."[8]

Furthermore, on January 2001, Canada and the U.S.A. have signed the "Letter of Understanding Between the Federal Communications Commission of the United States of America and Industry Canada Related to the Use of the 54-72 MHz, 76-88 MHz, 174-216 MHz and 470-806 MHz Bands for the Digital Television Broadcasting Service Along the Common Border"

The above statement indicates that Canadian TV stations operating near the US border are protected. An arrangement for the deployment of public safety mobile service on both side of the border is required. The PS operators close to the US border may be a direct source of CCI for TV channels assigned to 63 and 64 and 68 and 69 in the interim period and to DTV channel 64 and 69 on a regular basis. The test results should provide input to the tolerable levels of ACI and CCI for these scenarios.

[8] §166, FIRST REPORT AND ORDERAND THIRD NOTICE OF PROPOSED RULEMAKING Adopted: August 6, 1998

5 Laboratory Test Parameters and Test Scenarios

5.1 Introduction

The interference scenarios presented in this study were evaluated after collecting the relevant information regarding power, emission limits and the rules and regulations regarding co-existence of PS and TV in the band. These parameters were used as a guide for the development of a test plan for the study as well as to create the interference signals since standardized PS equipment was not available.

Future PS equipment that will operate in the 700 MHz band will be only available in a digital format. There will be no interim period for which analog mobile services will be offered in this band. Speedy deployment of PS in this band is facilitated by the availability of digital equipment using CQPSK for 12.5 kHz voice now used in the 800 MHz band. In preparing for this study, CRC attempted to obtain digital CQPSK field proven equipment for use as the undesired source of interference in the laboratory tests. Since this equipment was not available, the decision was made to conduct all tests using simulated undesired signals. These signals conform to the specifications associated with "Project 25"[9] where applicable, as well as any other available specification and the FCC guidelines.

The CRC study provides inputs regarding co-channel and adjacent channel interference that can be used in the Canadian Band Plan development. The new band plan will need to take into account any requirement for guard bands, the number of allowable channels that allow for TV and PS co-existence etc. on a non-interfering basis, as well as cross border issues. The basic assumption is that there will only be an all-digital PS mobile system implementation.

The parameters used in the CRC study have been extracted as they pertain to the public safety band from the public literature and publicly available standards. In this regard a study was made of the proposed US band plan and other documents. Information obtained regarding spectrum efficiency, base station transmitter power, and emission limits etc. was used in the development

[9] TIA/EIA standard "Project 25 FDMA Common Air Interface New Technology Standard Project Digital Radio Technical Standard" TIA/EIA-102.BAAA, May 1998.

of a test plan for this project as well as to generate the interference signal using the Arbitrary Function Generator (AFG) as no PS equipment was available.

It is assumed also that digital equipment specified in “Project 25” for public safety now being used in the 800 MHz in Canada may also be modified for used in the 700 MHz band to allow for immediate deployment in the US and possibly Canada. This equipment uses mostly 12.5 kHz for voice and data in a FDMA system format. Future equipment for voice will only be available for a 6.25 kHz voice channel.

It is noted that the technical specifications for transmitters designed for voice operation within a 12.5 kHz or 6.25 kHz bandwidth should conform to the ANSI/TIA/EIA102.BAAA-1 common air interface standard and the ANSI/TIA/EIA102.BABA for the vocoder. Transmitters designed for data transmission within a 12.5 kHz or 6.25 kHz bandwidth should conform to 5 standards. The ANSI/TIA/EIA 102.BAEA provides the data overview, the ANSI/TIA/EIA 102.BAEB provides for the packet data specification, the ANSI/TIA/EIA102.BAEC for circuit data description, the ANSI/TIA/EIA 102.BAEA radio control protocol and again the ANSI/TIA/EIA 102.BABA for the vocoder. Other related standards published in the first quarter of 2003 by the TIA are "Digital Radio Technical Standards - Public Safety Wideband Data Standards Project - Wideband Data System and Standards Definition," TSB-902.A. This standard enables interoperability in a wideband radio system using high-speed packet data over wideband data channels in the 700 MHz public safety band plan. The TIA has also published two other standards: "Wideband Air Interface (WAI) -- (SAM) Radio Channel Coding Specification -- Public Safety Wideband Data Standards Project -- Digital Radio Technical Standards," TIA-902.BAAD; and "Wideband Air Interface (WAI) Media Access Control/Radio Link Adaptation (MAC/RLA) Layer Specification Public Safety Wideband Data Standards Project Digital Radio Technical Standards," TIA-902.BAAC.

The information provided regarding the parameters of interest to the TV/mobile radio study was extracted from the publicly available documents on the FCC web site and any ANSI and or TIA standards that are available for public viewing.

5.2 Summary of Laboratory Test Parameters.

Appendix 3 provides the background information for the extraction of the test parameters from the published literature as follows:

5.2.1 Emission Limits

In Appendix 3, Tables A3.2 to A3.9 show the specification for the emission limits for both narrowband and wideband signals in the public safety band. The simulation files of all single channel signals used in the tests as shown in Table 5.1 were fed into an Arbitrary Function Generator (AFG) and the resulting spectrum verified to meet the FCC emission limits.

5.2.2 Spectrum Efficiency and Modulation

The signal simulation also took into account the spectrum efficiency and modulation, the details of which are in section A3.3 of Appendix 3. Table 5.1 summarizes the parameters used in the simulation of the PS interference signals:

In the table, the recommended modulation is based on what is used today for 12.5 kHz voice and what is expected to be implemented for data and video services in the future. Channels occupying 12.5 kHz and 100 kHz were not evaluated because of the short period of time allocated to this project and the fact that extrapolation can be used to obtain results for those bandwidths.

Table 5.1 - Modulation and Bandwidth of the Undesired PS signals used in the Tests

Occupied Bandwidth (kHz)	Recommended Modulation	Excess bandwidth (α %)
6.25	CQPSK	20
25	64 QAM	20
50	64 QAM	20
150	256 QAM	20

5.2.3 Interfering or undesired Signal (U)

The interfering or undesired signal levels used in the determination of the D/U ratio was the maximum level to achieve the Threshold of Visibility (TOV) and the maximum level to achieve ITU – R3 (slightly annoying) performance during the test conducted with desired DTV and NTSC respectively.

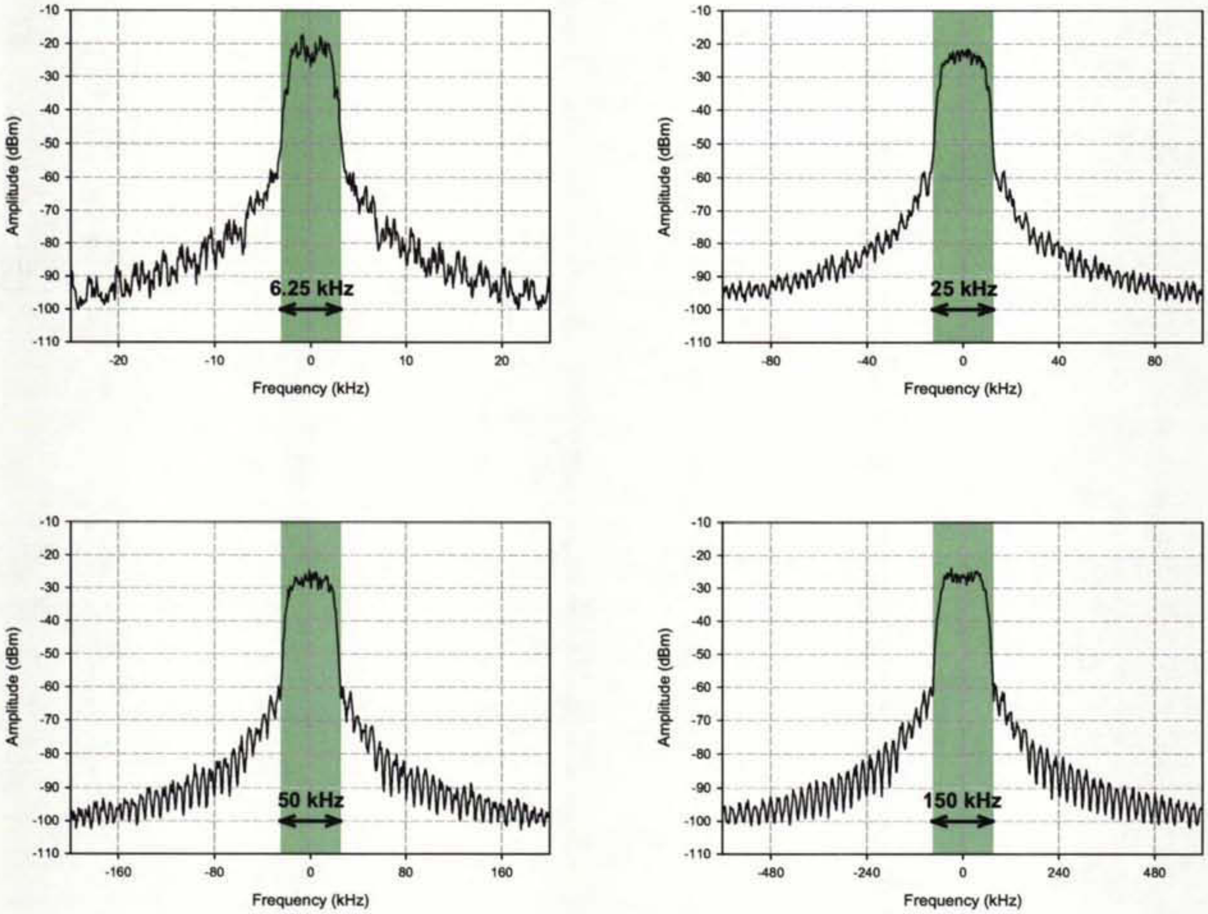


Figure 5.1 - Spectrum Plots of the interfering or undesired PS signal Used in the Tests

These PS undesired signals were the result of simulations and were implemented using the AFG, as no PS equipment was available. Figure 5.1 shows the spectrum of the four-interfering/undesired signals used to perturb the DTV and NTSC television signals during the single channel/sensitivity test. In-band (green area) and out-of-band spectral components were confirmed to meet emission limits. For the multi channel tests these signals were combined in accordance to the various scenarios given in Table 5.2 below.

5.2.4 Desired Signal (D)

In order to prevent tuners overload of the DTV and NTSC receivers all test were run using the signal level of –68 dBm and – 55 dBm for the desired signal for the DTV and NTSC signals respectively.

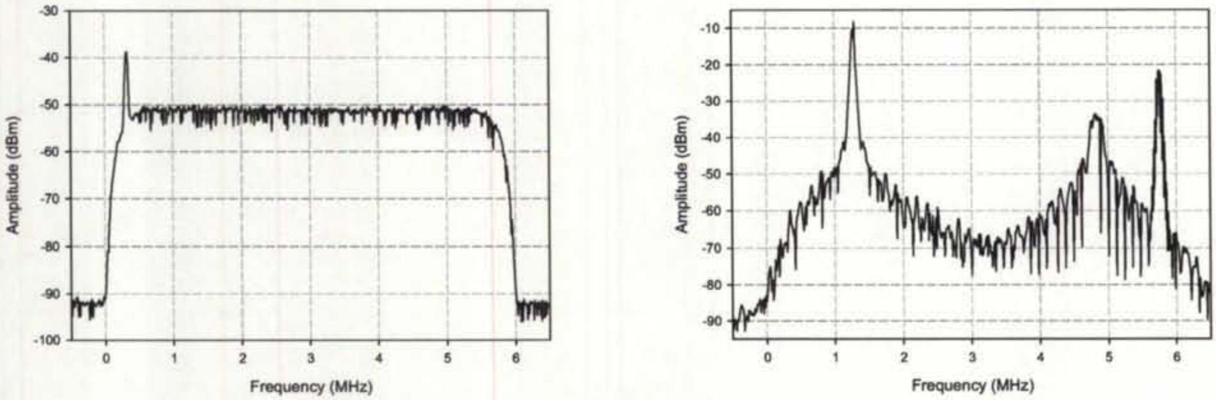


Figure 5.2 - Desired Signal DTV and NTSC Spectrum Plots

Figure 5.2 shows the signal spectrum for the DTV and NTSC signals used in this project. In the single DTV channel test, emphasis was placed on the measurement around the pilot, seen about 309 kHz above the lower edge of the channel. Similarly, the visual, chroma, and audio carriers were more closely analyzed for the NTSC case. These may be also seen in the NTSC plot of figure 5.2.

5.3 Laboratory Test

5.3.1 Single Channel Tests.

Single channels were used to test the sensitivity of the DTV and NTSC signals to the narrowband or wideband PS channel interfering signals given in table 5.1, also shown in figure 5.1. These tests were also conducted because of the possibility of a single channel system deployment in sparsely populated (supported by 30 or less mobile) areas.

For the single channel tests, a single modulated PS carrier was used to sweep in discrete steps across the TV channel on a co-channel and adjacent channel basis in order to determine the sensitivity of the DTV and NTSC signals to such interference. The sweep step was incremented by an integral number of channels each time. For each step, the level of the PS interference was increased until the TOV for DTV and ITU-R3 (slightly annoying picture or sound) performance for NTSC was achieved.

Table 5.2 - DTV and NTSC Single Channel Test

Interfering Signal Classification	DTV	NTSC
	Interferer Bandwidth (kHz)	Interferer Bandwidth (kHz)
Narrowband	6.25	6.25
Narrowband	25	25
Wideband	50	50
Wideband	150	150

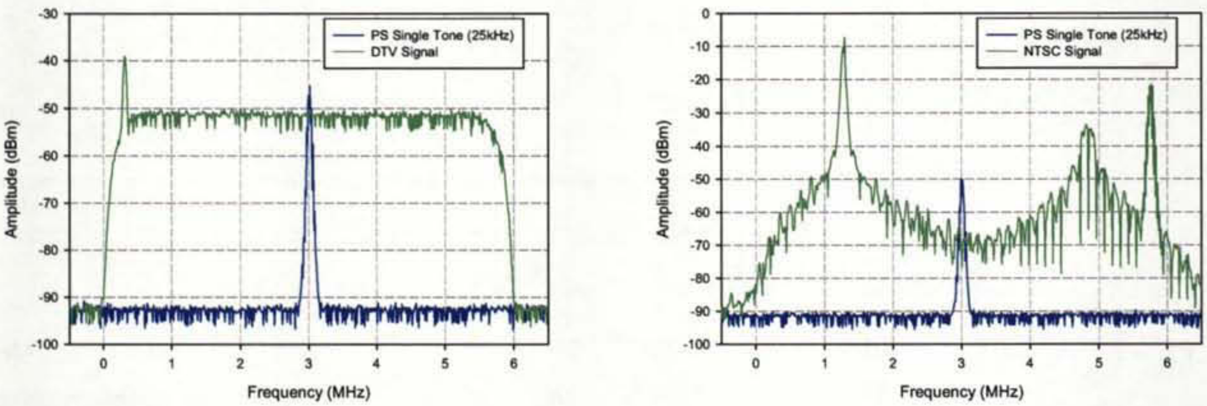


Figure 5.3 - Single Channel (25 kHz) into DTV (at TOV) and NTSC (at ITU-R 3)

The eight tests listed in Table 5.2 were performed under the single channel test process. These test results help identify the sensitive areas of both DTV and NTSC signals where more protection may be needed and areas that must be avoided during system implementation.

The plots of the DTV and NTSC signals with a 25 kHz PS channel interfering signal level at the threshold of performance are shown in figure 5.3. These PS signals are expected to be at a lower level in the vicinity of the pilot for DTV and the related carriers for NTSC.

For each of the two desired TV signals in figure 5.3 the four undesired PS signals in figure 5.1 were each used to sweep across the desired signal in band to obtain CCI threshold D/U performance. Also, to sweep ± 3 MHz above and below the channel to get the ACI Threshold D/U performance. These results are shown in Section 6 starting on page 19.

5.3.2 Multi-Channel Test

For the multi channel test, some typical combinations of narrowband and wideband channels were generated as listed in the scenarios in table 5.3. The power level of all the PS channels in each scenario was increased until the interference effect observed in DTV or NTSC was at the TOV and ITU-grade 3 respectively, and then this D/U value was recorded. The channel combinations was then shifted away from the TV channel by an integral number of PS channels (to determine the effects of increasing the guard band) then again the power level increased to TOV or ITU-R3 following which the D/U was again recorded. This test was repeated for 10 to 20 different guard bands for each scenario.

The number of times the test was done depends on the bandwidth of the PS channels in each scenario. The number of channels used in these tests was based on the maximum number of channels allowed in a single combiner. This is as a result of the practical requirement for a minimum of 250 kHz spacing between channels being combined.

Table 5.3 shows the eight scenarios tested for this report. It shows (under "Chan. Sep") that the separation was 250 kHz or 300 kHz and the total number of channels (under "Num. Of Channels") in any one-test scenario is either 22 or 24. For example, according to scenario F, in the table, the bottom 3 MHz of the multi channel signal consists of 12 – 25 kHz narrowband signals while the top 3 MHz consists of 12 – 50 kHz wideband signals. This multi channel scenario represents a total of 24 PS channels.

Table 5.3 - Test Scenarios for the Multi-channel Tests

Scenario	Chan. # Start[10] (Chan. Desig*)	Chan. BW (kHz)	Chan. Sep. (kHz)	Num. of Channels	Mod. (QAM)
A	13 (NB – 13)	6.25	250	12	CQPSK
	1 (WB 1-3)	150.00	300	10	64
B	4 (NB 13-16)	25.00	250	12	64
	1 (WB 1-3)	150.00	300	10	256
C	21 (WB 61-63)	150.00	300	10	64
	481 (NB – 481)	6.25	250	12	CQPSK
D	21 (WB 61-63)	150.00	300	10	256
	121 (NB 481-484)	25.00	250	12	64
E	13 (NB – 13)	6.25	250	12	CQPSK
	1 (WB - 1)	50.00	250	12	64
F	4 (NB 13-16)	25.00	250	12	64
	1 (WB – 1)	50.00	250	12	64
G	61 (WB - 61)	50.00	250	12	64
	481 (NB – 481)	6.25	250	12	CQPSK
H	61 (WB – 61)	50.00	250	12	64
	121 (NB 481-484)	25.00	250	12	64

*In this parenthesis, the numbers represent the actual channel numbers of the first 6.25 kHz narrowband or first 50 kHz wideband channels, according to the FCC band plan, that are combined to create the channel bandwidth used in that scenario.

Also, for scenario F, the last column in the table shows that each PS channel used a 64 QAM modulation.

The "Chan. # Start" column also indicates the first narrowband or wideband channel number[10] for bandwidth shown (under "Chan BW") that was used to generate the multi channel signal. The remaining channel numbers may be determined by repeatedly adding the factor derived when the channel spacing is divided by the channel bandwidth also shown (under "Chan. BW"). This

[10] For narrowband channels with bandwidths larger than 6.25 kHz and wideband channels with bandwidths greater than 50 kHz, these numbers represent the combined channel block number. The corresponding FCC designated channel number is under "Chan. Desig." shown in parenthesis in the table. E.g. in scenario D, the first 25 kHz narrowband channel used in the multi channel signal is the 121st block of 4, 6.25 kHz channels with the FCC designated channels 481-484 being combined to create block 121.

numbering scheme shown under the "Chan. # Start" column was used to simplify the presentation of all figures and tables where combined basic narrowband and wideband channels (6.25 kHz and 50 kHz) are used to create 6 MHz bandwidth PS scenarios.

It is noted that for the case of the narrowband channels, the first high power channel starts at 13 for the 6.25 kHz channels and at channel 4 (i.e. 6.25 kHz channel numbers13-16) for the 25 kHz channel. This is because channels below 13 and 4 will only be used for low power applications therefore, base stations etc. will not occupy these channels. This rule also applies to the last 13-narrowband channels 947 to 960 in the lower PS block. A similar rule applies to the upper PS block.

The table also shows that 256 QAM modulation was used in test scenarios B and D. Although there is no evidence that such a high ary system will be implemented the intention was to verify that there were no significant change in D/U ratio as a function of the modulation level as compared to the other scenarios.

As an example, the desired DTV and NTSC signals are shown in figure 5.4 along with the undesired PS multi channel signal for scenario F at their performance threshold (TOV and ITU-R3). As expected, the peak power of the PS signal is lower than the single channel case because the total power must now be distributed among several channels. Further observations of the undesired PS signal show approximately a 5 dB of amplitude slope across the bandwidth of both the DTV and NTSC signals spectrum.

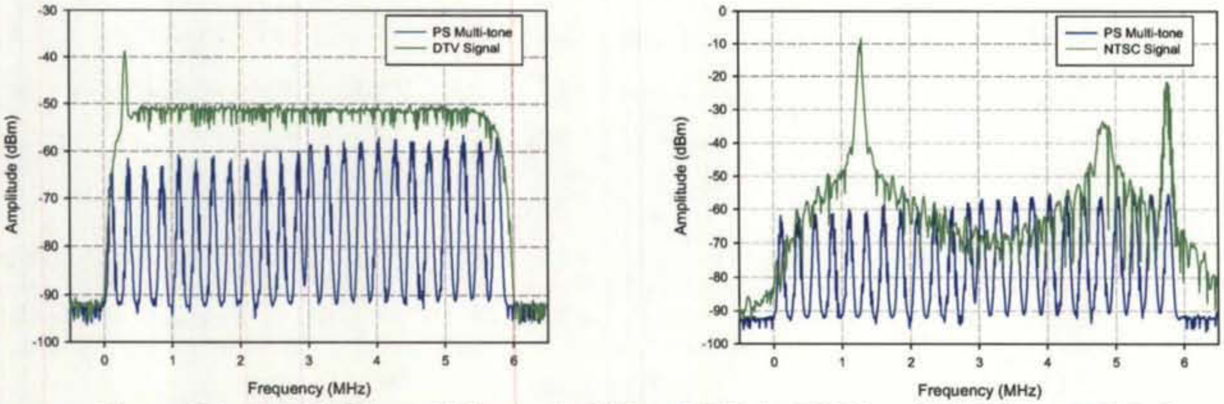


Figure 5.4 – Multi-Channel (Scenario F) into DTV (at TOV) and NTSC (at ITU-R 3)

This is the practical result of converting a simulated file with the AFG to create a real signal, which is amplified and filtered during the test measurement process. This anomaly will account for some experimental error. In a real system implementation where the transmitters for each channel are independent, this anomaly is not expected.

For the desired DTV and NTSC signals in figure 5.4 the PS multi channel undesired signals (blue in figure 5.4) combination as listed in the various scenarios in table 5.3 were used to sweep across the desired signal in band to obtain CCI threshold D/U performance. Obviously, for the case of CCI only 1 D/U value is possible because the multi channel PS signal occupies the full bandwidth of the desired signal. Also, for the adjacent channel results, the PS undesired signal for each scenario was used to sweep ± 3 MHz above and below the desired channel to get the ACI threshold D/U performance. The test results of the eight possible scenarios are shown in Section 7 starting on page 29.

6 Single Channel Test Results and Discussion

6.1 DTV Single Channel Performance

Figure 6.1 and 6.2 show the performance of a DTV channel when perturbed by a single narrowband and a wideband channel interferer respectively. The horizontal axes on the top and the bottom of each figure give the frequency and related channel numbers respectively. The various undesired signal bandwidths are shown in distinguishing colors. This convention has been adopted for all the figures of the results. Results are presented up to 3 MHz above and below the TV channel. Beyond this band, results are extrapolated on a conservative basis, as time did not permit further measurements. These extrapolations are shown by dotted lines in the figures. Also, the CCI performance areas are highlighted in yellow. Elsewhere, are regions of ACI.

The figures show that the overall performance is within one dB of each other in both the narrowband and wideband channel cases. For the DTV signal, in both cases, additional protection i.e. a higher D/U ratio is required around the pilot and the center of the band especially in the narrowband case. This is because of the effect of the interference on the local oscillator associated with the pilot and carrier recovery circuitry. The other area of interest is the area where the DTV notch filter is located. At that area, less protection is required. However, for long term planning purposes, that area may disappear when NTSC is eliminated. This is because the notch filter is implemented in some DTV receiver only to protect DTV signal against the interference from the NTSC visual carrier. Thus in the absence of that notch filter, the trend is for the signal to flatten out in that area.

In order to get a true picture of the impact of operating PS in channel 63 (by extension channel 68) on the co-channel (DTV or NTCS in channel 63 along with PS) and on the adjacent TV channels 62, 64, 67, and 69, the results in figures 6.1 and 6.2 must be combined. Thus, combining the results obtained from the Figures 6.1 and 6.2, the ACI and CCI performance of DTV channels 63 and also 64 are shown in figure 6.3 and figure 6.4 respectively.

The CCI interference case for channel 63 will only be valid during the interim PS deployment when channel 63 may be used for DTV.

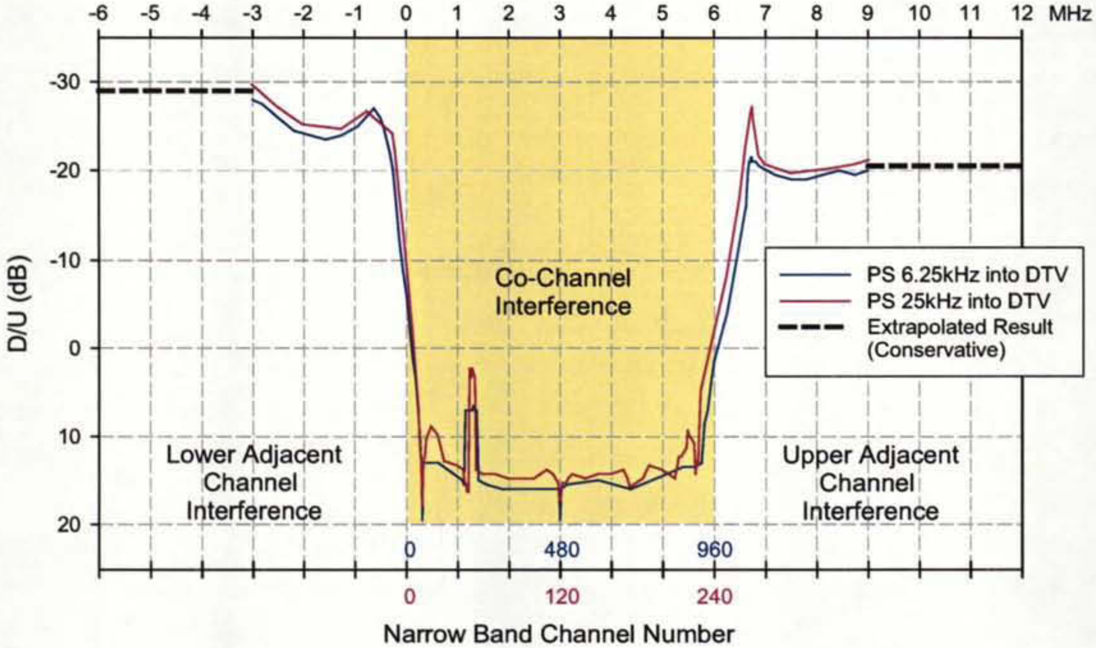


Figure 6.1 – DTV Channel Performance with a 6.25 kHz & 25 kHz PS Interferer

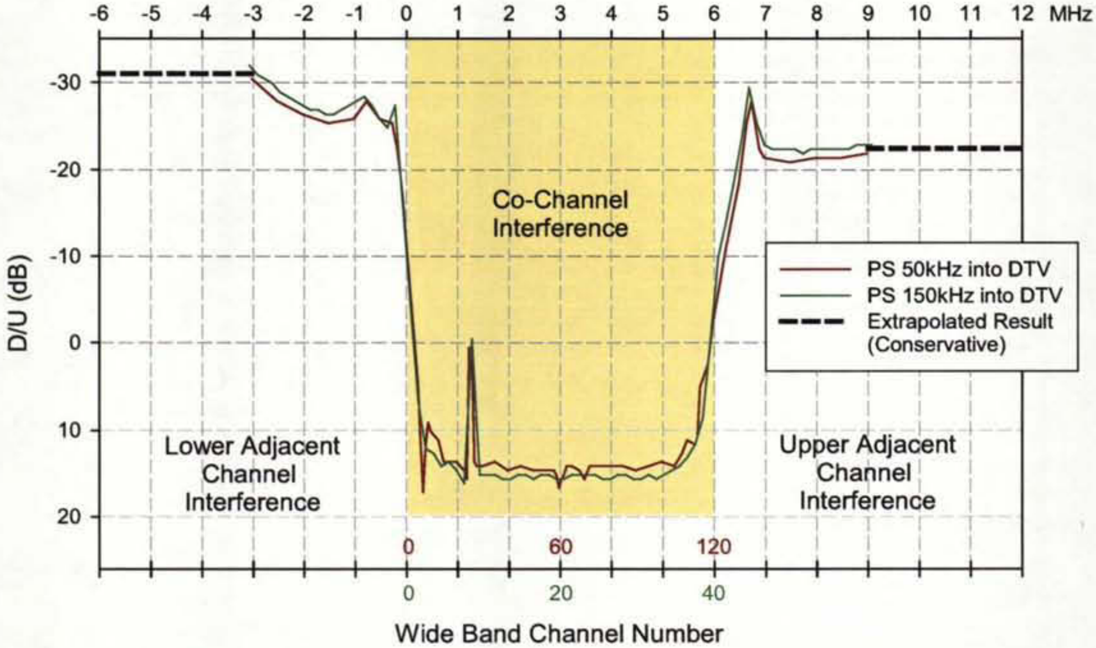


Figure 6.2 – DTV Channel Performance with a 50 kHz & 150 kHz PS Interferer

Referring to figure 6.3, which represents the D/U performance of DTV channel 63, the top half represents ACI performance of channels 62 and 64 with PS operating in channel 63. The bottom half of the figure represents the CCI performance that resulted from narrowband and wideband PS interference in channel 63 into a DTV channel also in 63. Furthermore, the ACI performance in the upper left quadrant is that generated in DTV channel 62 by narrowband PS operating in channel 63.

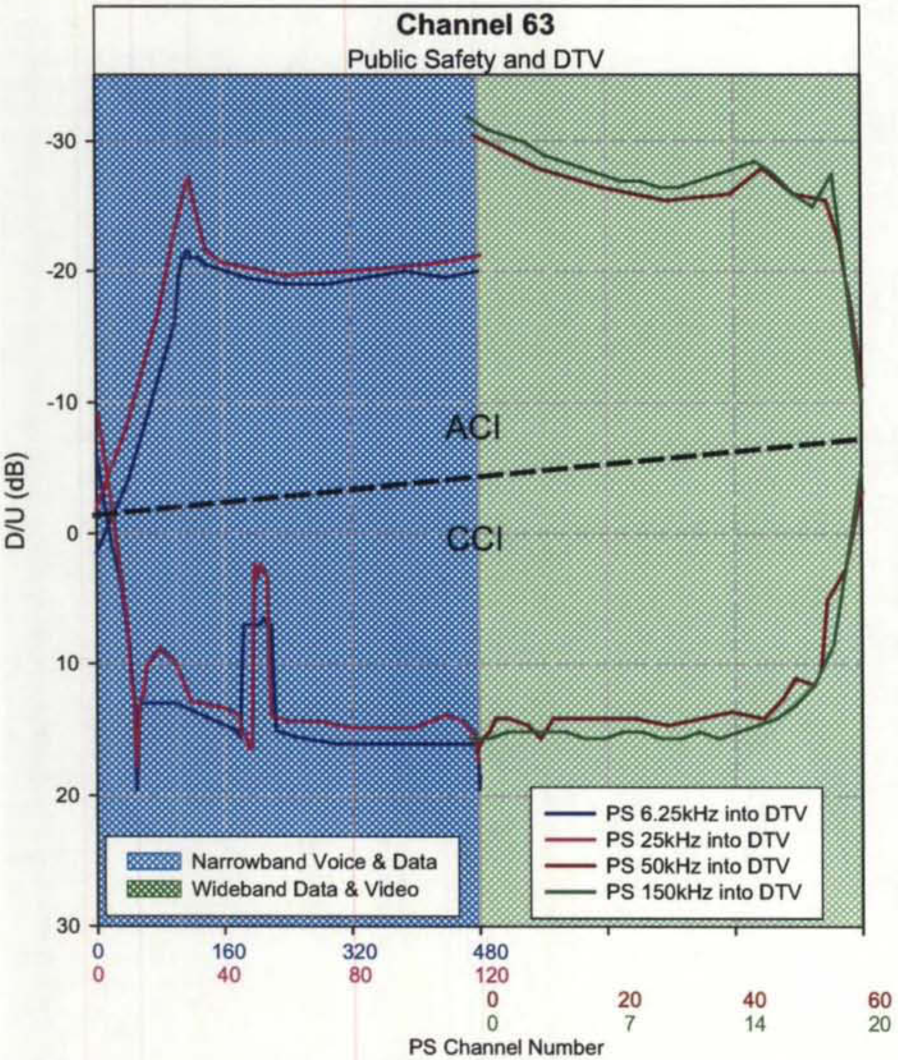


Figure 6.3 - D/U Performance of DTV Channel 63 with PS NB and WB Interference

The corresponding PS channel number on the horizontal axis plays a dual role. When the figure is being used for CCI evaluation, the channel number is the exact inband channel creating the

CCI for that D/U ratio. When the figure is being used for ACI evaluation, the channel number represents an equivalent out of band channel i.e. the mirror image of that channel number below the bottom edge of channel 63.

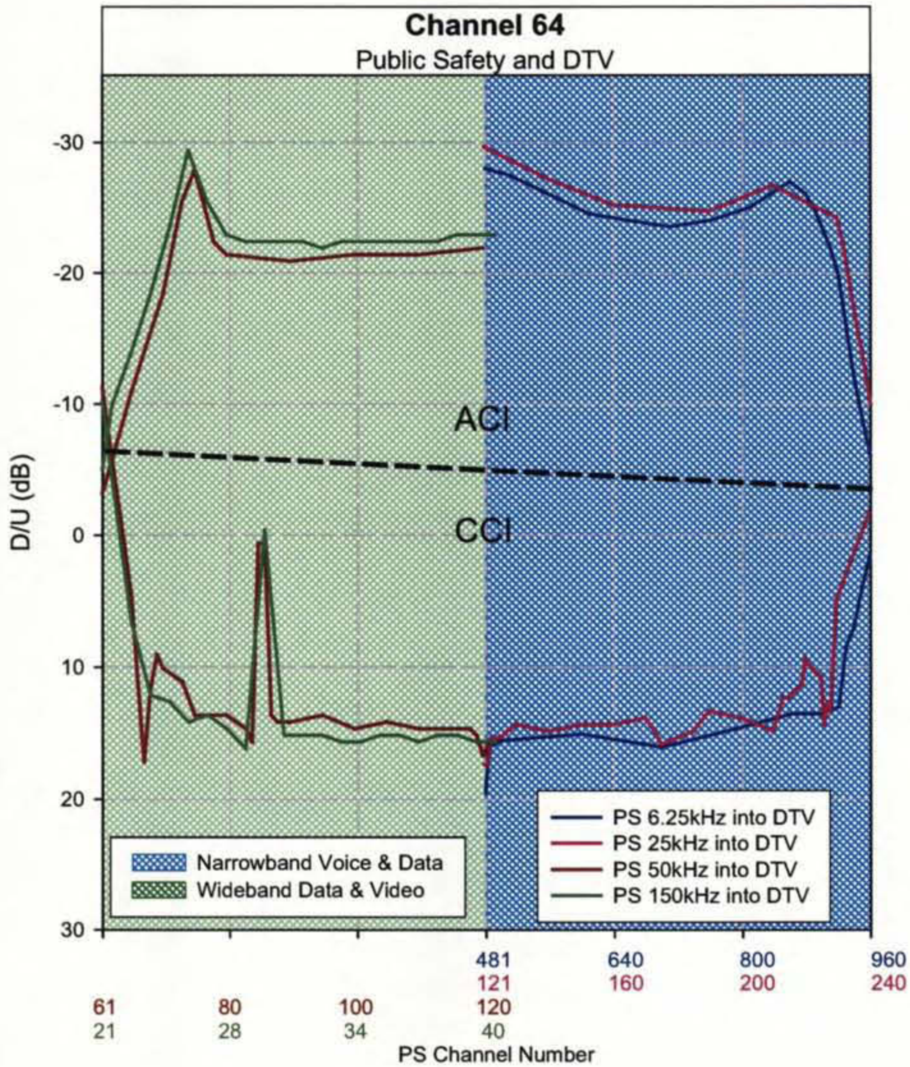


Figure 6.4 - D/U Performance of DTV Channel 64 with PS NB and WB Interference

Therefore, using this number to multiply the channel bandwidth relevant to that quadrant would provide the frequency below the bottom edge of channel 63 for which that D/U ratio is valid. Again keep in mind that PS is operating in channel 63. Likewise, the ACI in the top right quadrant provides similar information regarding the ACI performance of channel 64 created by wideband PS operating in channel 63. Again the corresponding PS channel creating the interference is shown on the horizontal axis with the same rule as above except now the channel creating the ACI is above the top of channel 63.

Referring to figure 6.4, which represents the D/U performance of DTV channel 64, the top half represents ACI performance in TV channels 63 and 65 with a similar explanation as presented for figure 6.3. Similarly, the bottom half represents the CCI performance that resulted from narrowband and wideband PS interference from PS operations in channel 64 on DTV in channel 64. Again here the interpretation of the various quadrants and the actual channel number creating the relevant D/U performance is the same as for channel 63. The difference now is that the lower 3 MHz of channel 64 is perturbed by wideband PS interference while the upper 3 MHz by narrowband PS interference. Also, the ACI performance shown in DTV channel 64 is that affecting channel 63 and 65 resulting from PS operation in DTV channel 64. This scenario should only be an issue for TV operations close to the Canada US border.

For both DTV channel 63 and DTV channel 64 the bottom two quadrants represent the CCI performance of either channel with that in the left quadrant representing narrowband/wideband PS interference, similarly the right quadrant represent wideband/narrowband PS interference into the respective DTV channel.

For both channel 63 and 64 the figures show that the upper adjacent channel provides a higher D/U margin (in excess of –25 dB) than the lower adjacent channel where the D/U is in the order of 20 dB. The results in figures 6.3 and 6.4 apply equally to channels 68 and 69 respectively where the corresponding mobile transmitters etc. will be located.

Details of the DTV single channel test results may be found in Appendix 5 tables A5.1 (6.25 kHz into DTV), A5.3 (25 kHz into DTV), A5.5 (50 kHz into DTV), A5.7 (150 kHz into DTV). From those tables the D/U ratio created by a specific PS channel numbers at the TOV may be either obtained directly or interpolated for various points of interest in the figures.

As in figures 6.1 and 6.2, figures 6.5 and 6.6 provide the NTSC TV channel performance in the presence of narrowband and wideband channel PS interference respectively. These figures show that the region around the picture, chroma and audio carriers require more protection than elsewhere. Additionally, less robustness is exhibited in the lower adjacent channel than in the upper adjacent channel due, probably, to intermodulation effects close to the NTSC video carrier. Here also measurements were only taken to within 3 MHz of the edge. The expected results in the figure are shown with dotted lines. These are a result of extrapolating the measurement trend.

For the case of the NTSC performance when perturbed by a PS wideband channel, only a 150 kHz PS interfering signal was used in the results because of a lack of time. Based on trend shown in the other results in this report, it is expected that the NTSC performance with a 50 kHz PS interferer would be within one or two dB of the performance shown for the 150 kHz case.

As in figures 6.3 and 6.4, figures 6.7 and 6.8 shows the actual channel performance that may be expected as a result of both narrowband and wideband undesirable signal interference into the NTSC channels 63 and 64 respectively. Once again the occupancy of channel 63 by an NTSC channel will be an interim position and so this scenario will vanish with time. CCI interference in channel 64 is mostly a US border issue. The explanation as to how to interpret the figures is the same as explained for figures 6.3 and 6.4

NTSC Single Channel Performance

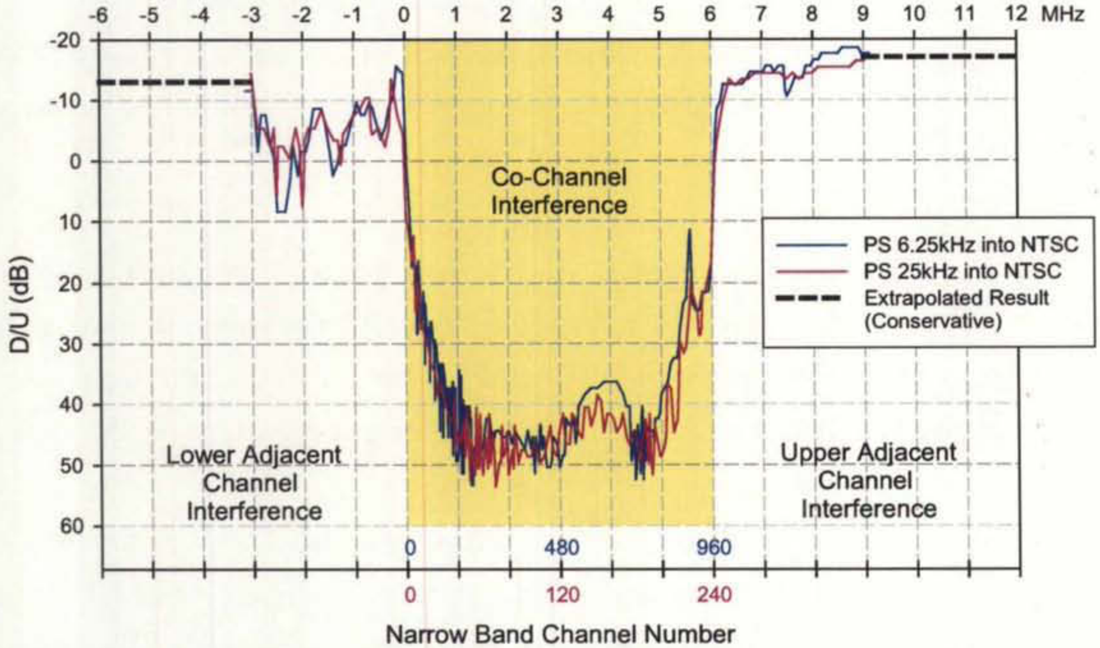


Figure 6.5 – NTSC Channel Performance with a 6.25 kHz & 25 kHz PS Interferer

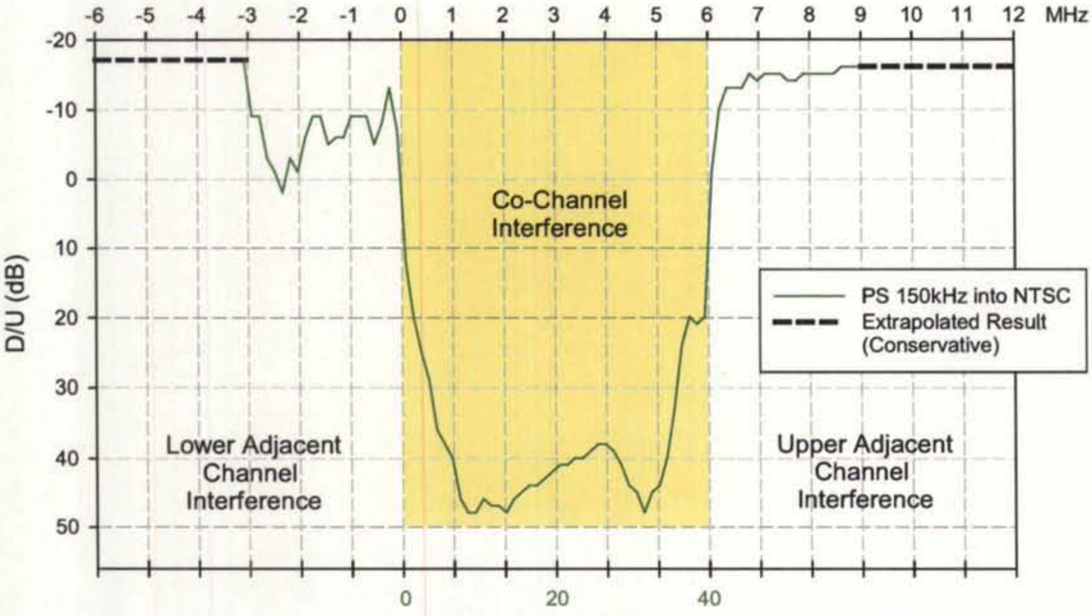
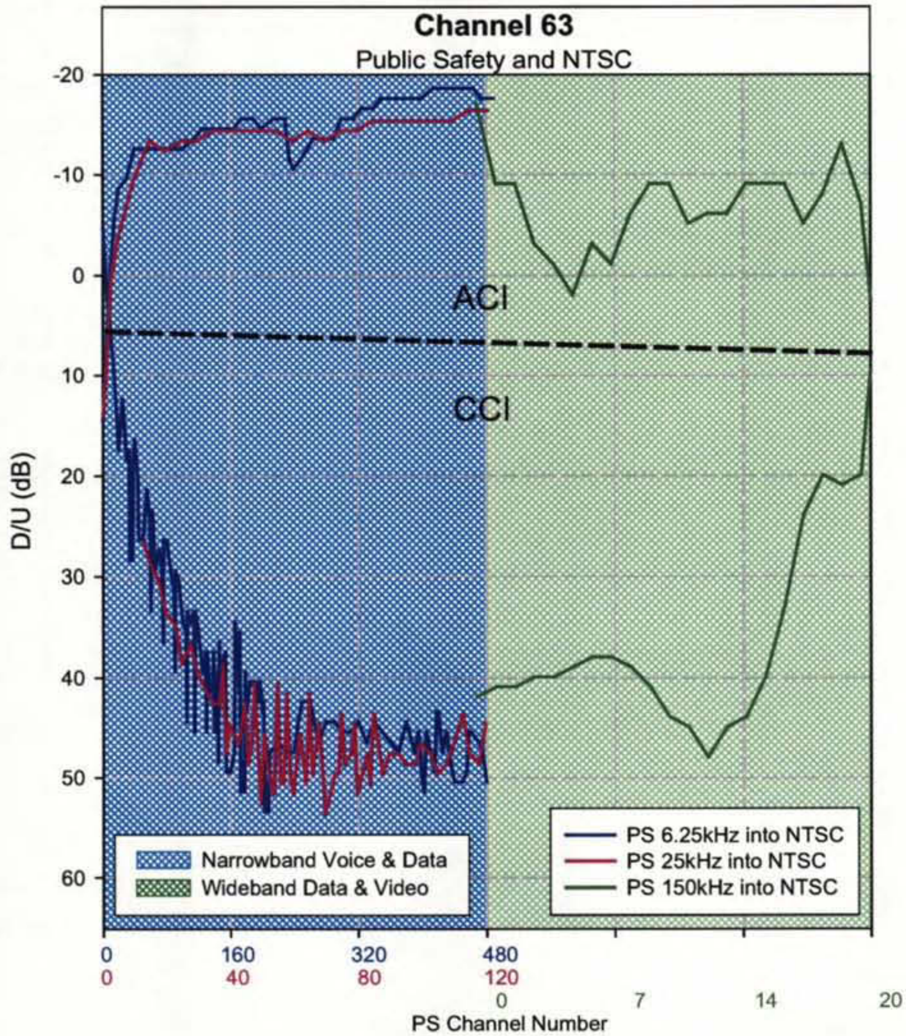


Figure 6.6 – NTSC Channel Performance with a 50 kHz PS Interferer

The results also show that much higher protection ratios are required to sustain the NTSC signal at an acceptable grade of service as compared with DTV under the same conditions.

Figure 6.7 – D/U Performance of NTSC Channel 63 with PS NB and WB Interference



With respect to adjacent channel protection margins for the NTSC case, the interference created by the PS signals in channel 63 on the upper adjacent channel namely channels 64 is not tolerated as well as in the lower adjacent channel namely channels 62. A similar observation is also true for PS operations in channel 64. As mentioned before, this is probably due to intermodulation effects occurring around the NTSC video carrier.

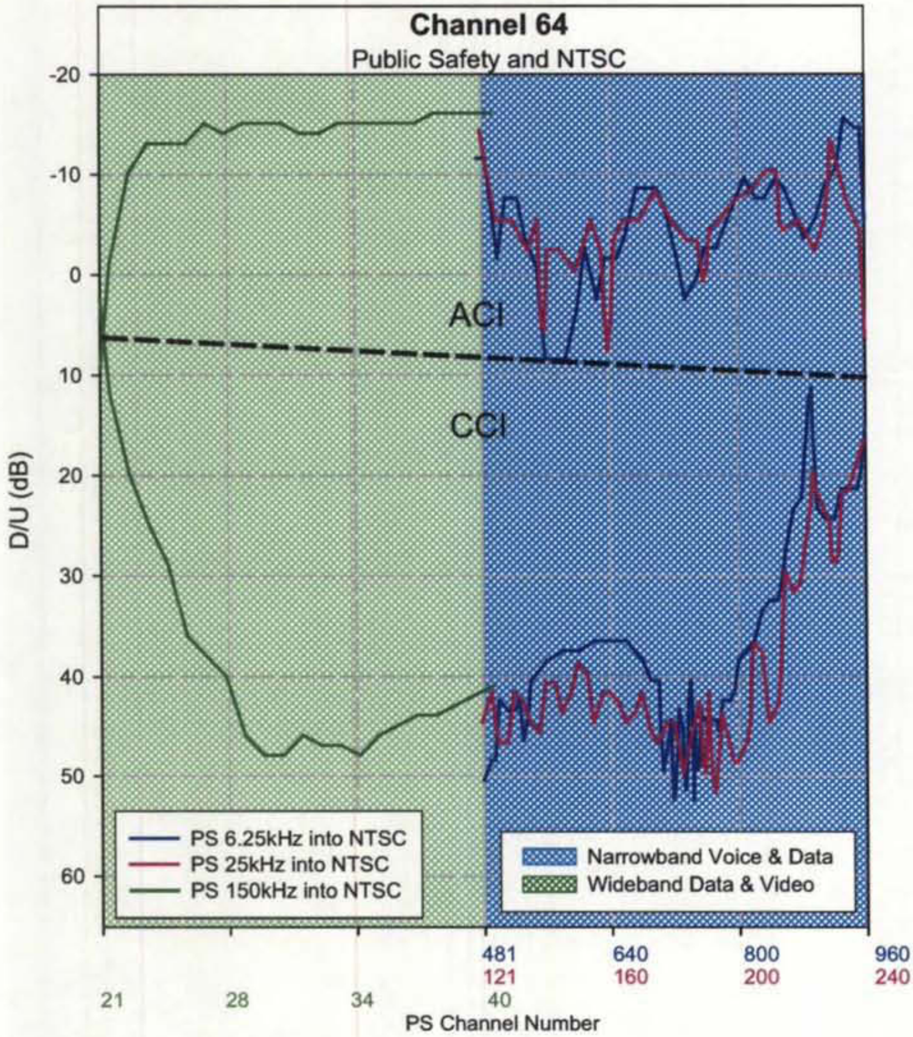


Figure 6.8 – D/U Performance of NTSC Channel 64 with PS NB and WB Interference

Here again, the results for channel 63 and 64 apply equally to channels 68 and 69 respectively. The interpretation of the axes and explanation of the information portrayed in the figures are the same as explained above.

Here also, the interference issues associated with NTSC channels 64 and 69 should only need to be considered in the vicinity of the Canada US border. While the performance of NTSC channels 63 and 68 is also affected by US PS operators close to the border, Canadian PS operations in those channels will affect TV broadcasting on channels 63 and 68 in the interim.

The microscopic details of the NTSC test results may be found in Appendix 5 tables A5.2 (6.25 kHz into NTSC), A5.4 (25 kHz into NTSC), and A5.8 (150 kHz into NTSC). From those tables the D/U ratio created by a specific PS channel numbers at the ITU – R3 (slightly annoying) threshold may be either obtained directly or interpolated for various points of interest in the figures.

7 Multi-Channel Test Result and Discussion

7.1 DTV and NTSC Multi-Channel Performance

Table 7.1 is a duplication of table 5.3 repeated here for convenience in explanations and to show the various multi channel scenarios for which DTV and NTSC performance results were obtained. Eight scenarios are depicted.

Table 7.1 Test Scenarios for the Multi-channel Tests.

Scenario	Chan. # Start[11] (Chan. Desig*)	Chan. BW (kHz)	Chan. Sep. (kHz)	Num. of Channels	Mod. (QAM)
A	13 (NB – 13)	6.25	250	12	CQPSK
	1 (WB 1-3)	150.00	300	10	64
B	4 (NB 13-16)	25.00	250	12	64
	1 (WB 1-3)	150.00	300	10	256
C	21 (WB 61-63)	150.00	300	10	64
	481 (NB – 481)	6.25	250	12	CQPSK
D	21 (WB 61-63)	150.00	300	10	256
	121 (NB 481-484)	25.00	250	12	64
E	13 (NB – 13)	6.25	250	12	CQPSK
	1 (WB - 1)	50.00	250	12	64
F	4 (NB 13-16)	25.00	250	12	64
	1 (WB – 1)	50.00	250	12	64
G	61 (WB - 61)	50.00	250	12	64
	481 (NB – 481)	6.25	250	12	CQPSK
H	61 (WB – 61)	50.00	250	12	64
	121 (NB 481-484)	25.00	250	12	64

*In this parenthesis, the numbers represent the actual channel numbers of the first 6.25 kHz narrowband or first 50 kHz wideband channels, according to the FCC band plan, that are combined to create the channel bandwidth used in that scenario.

Each case represents a different combination of narrow and wideband PS signals used in the tests. Each narrowband and wideband segment consists of 3 MHz. Also, the total number of

[11] For narrowband channels with bandwidths larger than 6.25 kHz and wideband channels with bandwidths greater than 50 kHz, these numbers represent the combined channel block number. The corresponding FCC designated channel number is under "Chan. Desig." shown in parenthesis in the table. E.g. in scenario D, the first 25 kHz narrowband channel used in the multi channel signal is the 121st block of 4, 6.25 kHz channels with the FCC designated channels 481-484 being combined to create block 121.

narrowband and wideband signals in each 3 MHz segment is the maximum allowable under the channel separation ("Chan. Sep.") rule shown in the table.

The threshold D/U performance resulting from the PS multi channel interference is shown in the figures 7.1 to 7.8. The change of the threshold D/U performance as observed in the TV channel (highlighted yellow) in the figure resulted from moving the multi channel PS signal away from the TV channel (increasing the guard band).
The following description, using scenario A as an example, applies to all scenarios. Referring to figure 7.1 showing the results of scenario A, the red and green result curve represents multi channel D/U performance for DTV and NTSC respectively. According to scenario A, in table 7.1 the bottom 3 MHz of the multi channel signal consists of 12 – 6.25 kHz signals while the top 3 MHz consists of 10 – 150 kHz wideband signals. The number in the brackets e.g. (150) for the lower adjacent channel means that the closest PS channel to the TV channel is a 150 kHz channel. Similarly for the upper adjacent channel a 6.25 kHz is the closest channel to the TV channel. This is consistent with the way the 6.25 kHz and 150 kHz signals were combined for Scenario A. This multi channel signal represents a total of 22 PS channels.

The first narrowband channel is channel 13 and the first wideband channel is channel 1 based on the number convention adopted in this report (see footnote 6 on page 14). "Lower Adjacent" or "Upper Adjacent" in the figure means that the multi channel PS interference just describes is either below or above the TV channel being observed while the PS interference is being shifted.

When considering the upper adjacent channels, the PS channels below channel 13 for the case of 6.25 kHz (figures 7.1 and 7.5) and below channel 4 (NB13-16) for the case of 25 kHz (figures 7.2 and 7.6) are distinguished by a "black" demarcation line. Similarly, when considering the lower adjacent channels, the PS channels above channel 947 for the case of 6.25 kHz (figures 7.3 and 7.7) and above 236 (NB 943-947) for the case of 25 kHz (figures 7.4 and 7.8) are also distinguished by a "black" demarcation. For the upper adjacent channel the channels below and for the lower adjacent channel, the channels above these demarcation lines are bared for use by base station transmitters etc. In both of these cases low power applications are allowed in those bared channels. However, the measurement results for those barred channels are also included in the figures for information purposes.

For all measurements the multi carrier signal was shifted away from the TV channel by an integral number of channels, either narrowband or wideband as is shown in the figures. This, therefore, provides essentially the TV channel performance as the guard band is increased. Thus the top horizontal axis depicts the channel number while the bottom horizontal axis depicts the associated guard band.

Generally, all the results in figure 7.1 through figure 7.8 shows as expected, the trend that as the guard band is increased the D/U improves i.e. the TV channel is affected less by the level of the PS signal as the guard band increases.

Comparing the various scenarios shows that in some cases this trend is reversed, i.e. the TV channel is affected more with an increase in the guard band. This may be explained by the effect of intermodulation created within the multi channel PS signal. This intermodulation moves around as the PS signal moves and thus changes the shape of the curves from the expected continuously increasing curve to that shown in the figures.

Another trend is that the D/U ratio degrades consistently, the larger the combined PS multi channel signal bandwidth is. This is as expected, as in the limit, the D/U performance of the TV channels with multi channel PS would approach the Canadian parameters for both CCI and ACI with DTV interference. Finally, as may be expected, the modulation level (64, 256 QAM) did not have any significant impact on the result.

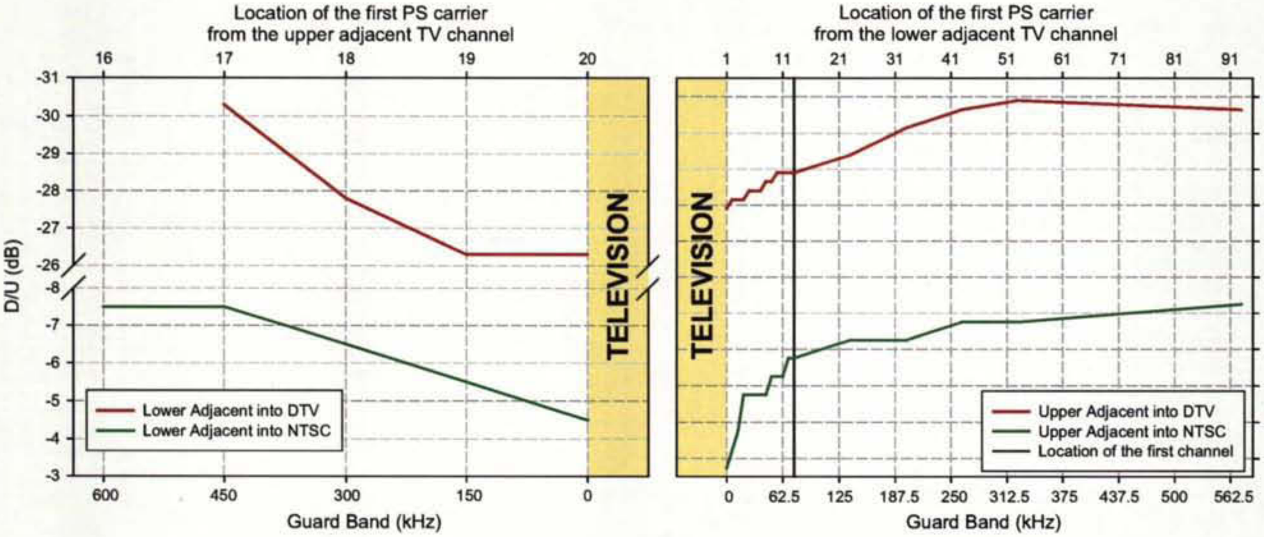


Figure 7.1 – Scenario A – PS Lower Adjacent (150 kHz) and Upper Adjacent (6.25 kHz) into DTV and NTSC

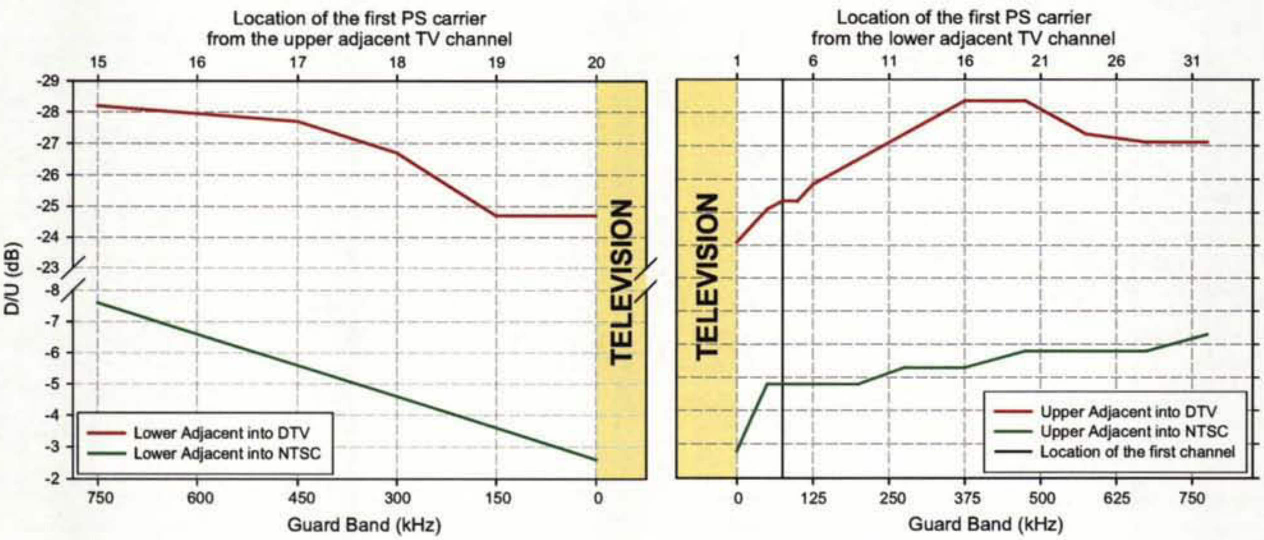


Figure 7.2 – Scenario B – PS Lower Adjacent (150 kHz) and Upper Adjacent (25 kHz) into DTV and NTSC

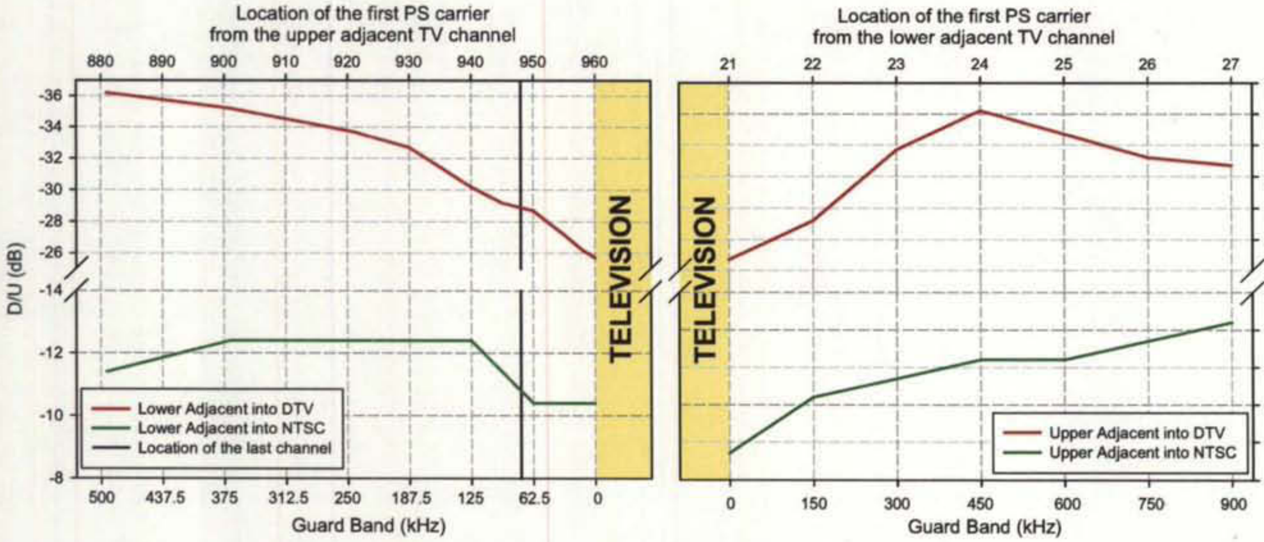


Figure 7.3 – Scenario C – PS Lower Adjacent (6.25 kHz) and Upper Adjacent (150 kHz) into DTV and NTSC

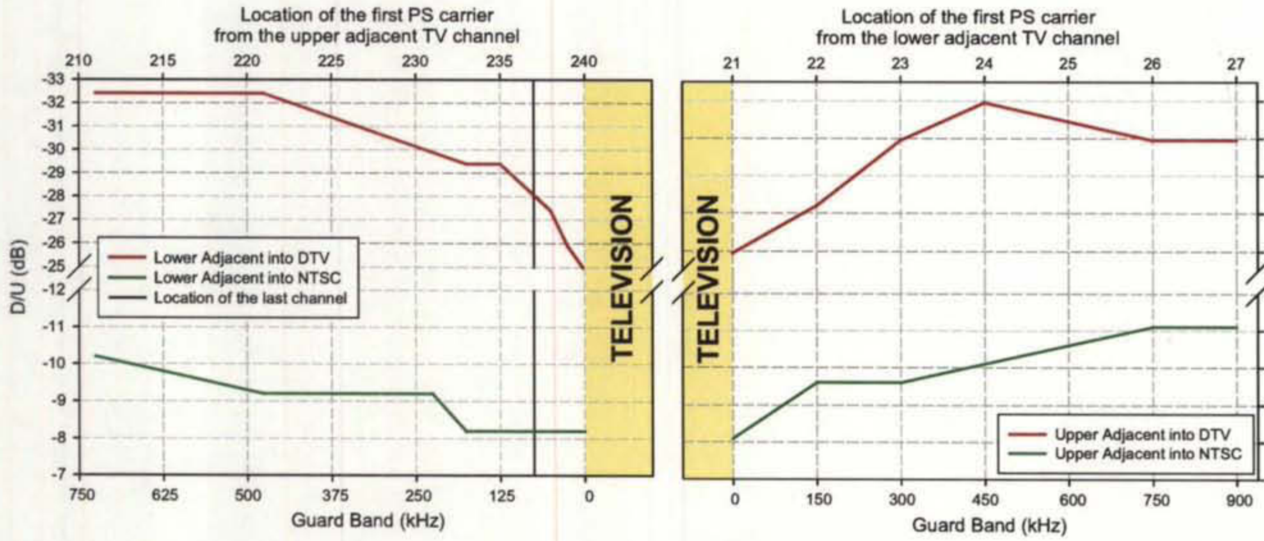


Figure 7.4 – Scenario D – PS Lower Adjacent (25 kHz) and Upper Adjacent (150 kHz) into DTV and NTSC

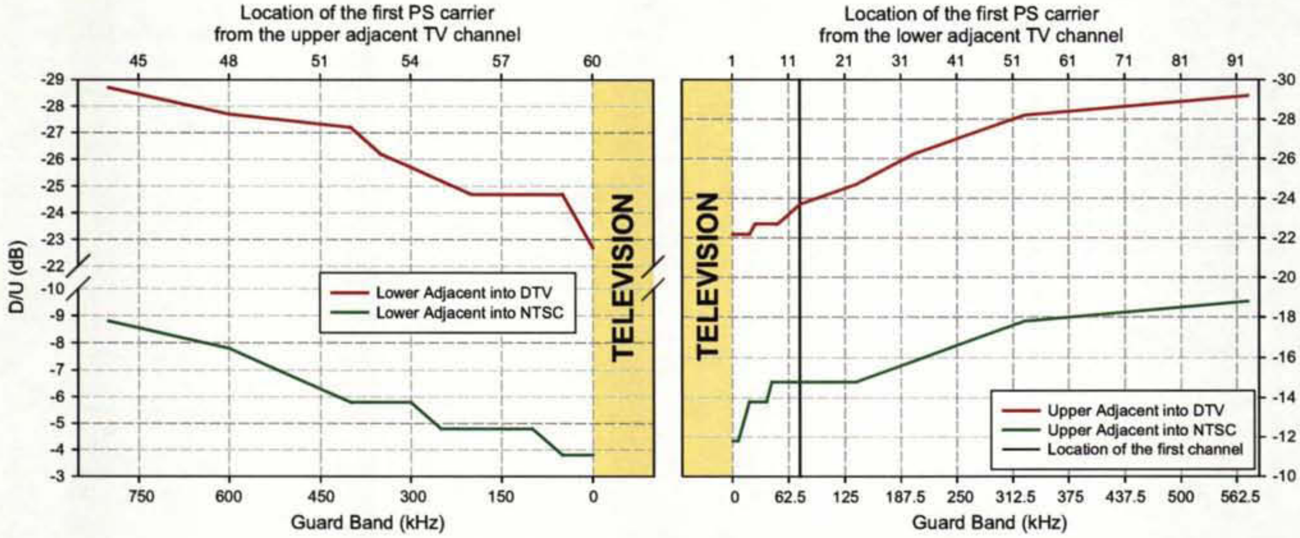


Figure 7.5 – Scenario E – PS Lower Adjacent (50 kHz) and Upper Adjacent (6.25 kHz) into DTV and NTSC

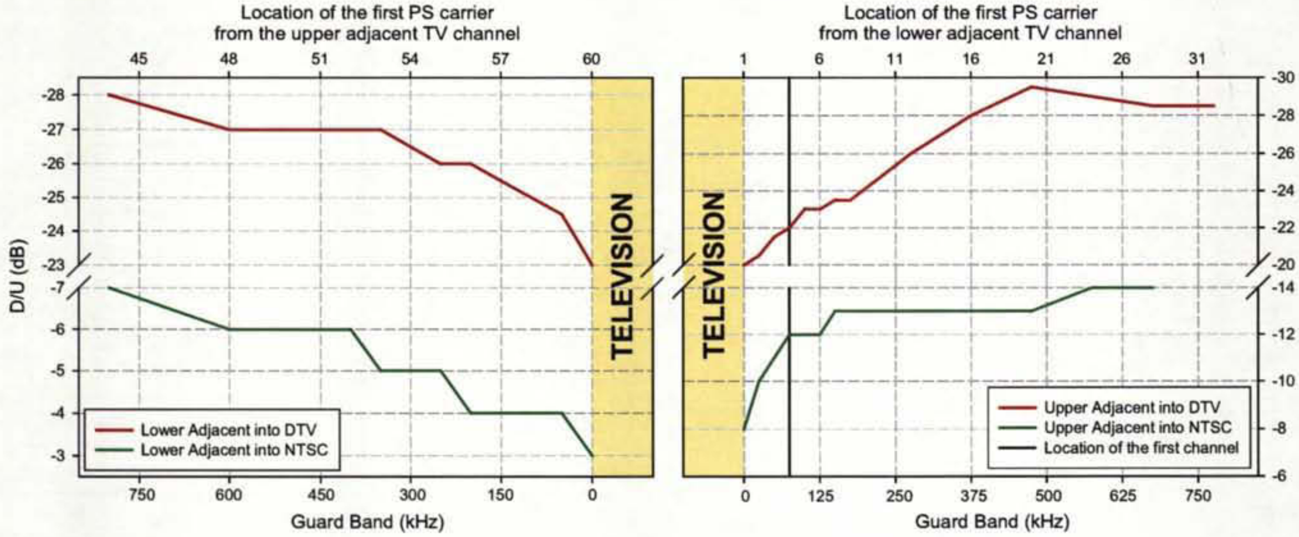


Figure 7.6 – Scenario F – PS Lower Adjacent (50 kHz) and Upper Adjacent (25 kHz) into DTV and NTSC

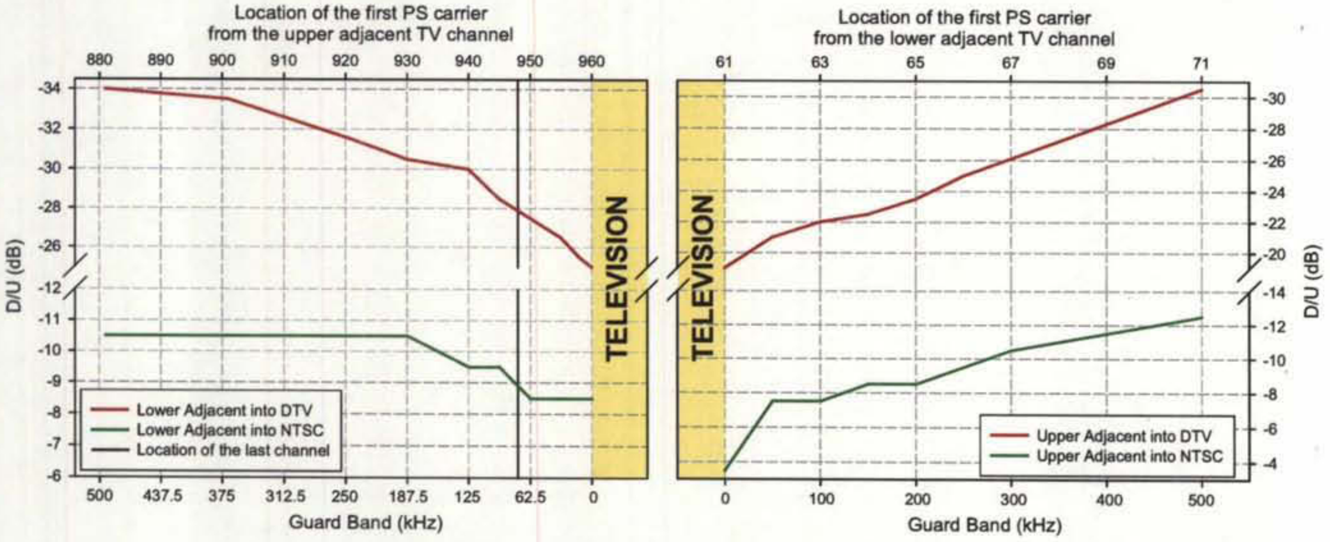


Figure 7.7 – Scenario G – PS Lower Adjacent (6.25 kHz) and Upper Adjacent (50 kHz) into DTV and NTSC

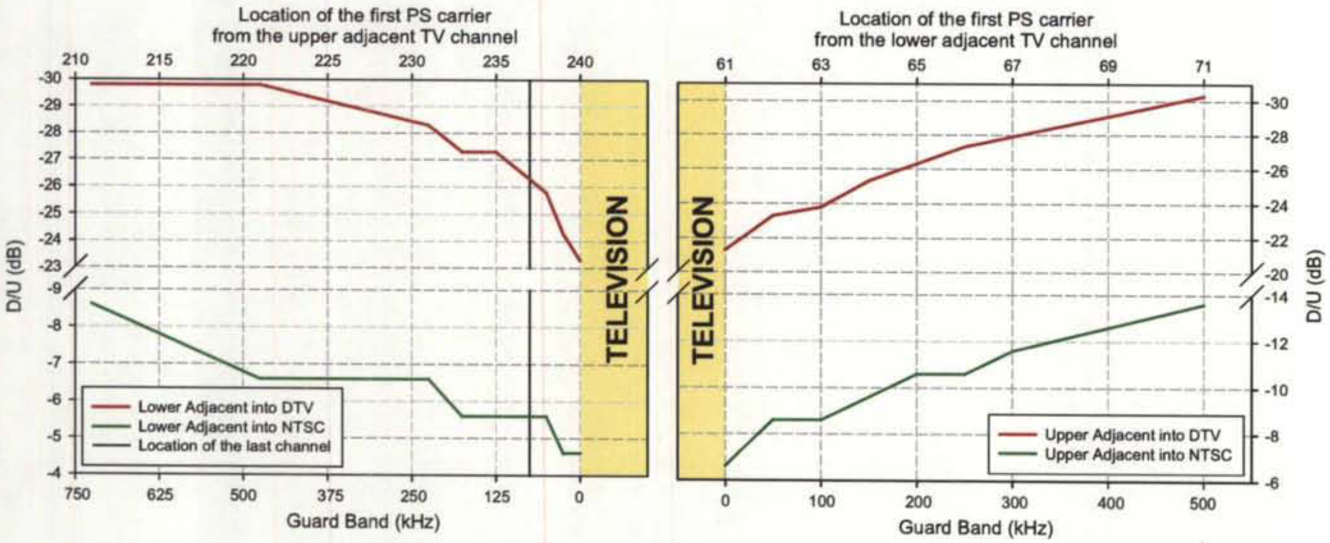


Figure 7.8 – Scenario H – PS Lower Adjacent (25 kHz) and Upper Adjacent (50 kHz) into DTV and NTSC

7.2 DTV and NTSC Multi-Channel Discussion

The following analysis is performed in order to determine if Canadian DTV planning parameters could be used for PS planning when implementing a PS multi channel system. To compare the multi-channel PS signal interference test results with the DTV allotment plan interference parameters, a correction factor must be used. This is because the DTV signal power is evenly distributed over the entire 6 MHz channel, while the multi-channel PS signal used in the test contains spectrum gaps.

The correction factor is defined as:

$$10 \times \log_{10} \{[\text{occupied multi-channel PS spectrum (MHz)}] / 6 \text{ MHz}\}$$

Table 7.2 Correction factors for each Test Scenarios for the Multi-channel Tests.

Scenario	Chan. BW (kHz)	Num. Of Channels	Useful Bandwidth (MHz)	Correction Factors (dB)
A	6.25	12	1.575	-5.8
	150.00	10		
B	25.00	12	1.800	-5.2
	150.00	10		
C	150.00	10	1.575	-5.8
	6.25	12		
D	150.00	10	1.800	-5.2
	25.00	12		
E	6.25	12	0.675	-9.5
	50.00	12		
F	25.00	12	0.900	-8.2
	50.00	12		
G	50.00	12	0.675	-9.5
	6.25	12		
H	50.00	12	0.900	-8.2
	25.00	12		

The calculated Correction Factors are listed in Table 7.2. With the Correction Factor, the multi-channel PS signal can be treated as an equivalent DTV signal. This assumes that total PS carrier power equals to the DTV power and that the PS carriers are transmitted over the entire 6 MHz TV spectrum.

It should be pointed out, if co-channel interference into DTV/NTSC services is not a concern, the PS carriers do not have to be transmitted at the same power level. Thus, those carriers close to the DTV/NTSC services that are a major adjacent channel interference source could be allowed to transmit at a lower power than the channels in the center of the PS band.

The results in tables 7.3 to 7.10 show that if the DTV signals were replaced by PS multi channels, they will meet or exceed the existing Canadian interference parameters for DTV in all cases except when the lower adjacent PS channel creates interference into NTSC. This finding applies to all scenarios except scenarios C and G.

Table 7.3 Comparison between interference created by DTV and PS Multi-channel for Test Scenario A.

Parameters	Value for Canada D/U (dB)	Multi-channel Tests Results D/U (dB)	Difference (dB) *	Difference with Correction Factors * (dB)
Co-Channel DTV into NTSC	**33.8**	36.5	2.7	-3.1
Lower adjacent channel DTV into NTSC	**-16**	-5.5	10.5	**4.7****
Upper adjacent channel DTV into NTSC	**-12**	-17.5	-5.5	-11.3
Lower adjacent channel DTV into DTV	**-27**	-26.3	0.7	-5.1
Upper adjacent channel DTV into DTV	**-27**	-27.8	-0.8	-6.6

*: A negative number indicate a better result by the multi-channel than interference created by DTV.
**: The multi-channel result doesn't meet the parameter requirement for the interference created by DTV.

Table 7.4 Comparison between interference created by DTV and PS Multi-channel for Test Scenario B.

Parameters	Value for Canada D/U (dB)	Multi-channel Tests Results D/U (dB)	Difference (dB) *	Difference with Correction Factors * (dB)
Co-Channel DTV into NTSC	**33.8**	37.4	3.6	-1.6
Lower adjacent channel DTV into NTSC	**-16**	-7.6	8.4	**3.2****
Upper adjacent channel DTV into NTSC	**-12**	-15.6	-3.6	-8.8
Lower adjacent channel DTV into DTV	**-27**	-24.7	2.3	-2.9
Upper adjacent channel DTV into DTV	**-27**	-26.7	0.3	-4.9

*: A negative number indicate a better result by the multi-channel than interference created by DTV.
**: The multi-channel result doesn't meet the parameter requirement for the interference created by DTV.

Table 7.5 Comparison between interference created by DTV and PS Multi-channel for Test Scenario C.

Parameters	Value for Canada D/U (dB)	Multi-channel Tests Results D/U (dB)	Difference (dB) *	Difference with Correction Factors * (dB)
Co-Channel DTV into NTSC	**33.8**	39.6	5.8	0
Lower adjacent channel DTV into NTSC	**-16**	-12.4	3.6	-2.2
Upper adjacent channel DTV into NTSC	**-12**	-7.4	4.6	-1.2
Lower adjacent channel DTV into DTV	**-27**	-33.7	-6.7	-12.5
Upper adjacent channel DTV into DTV	**-27**	-22.7	4.3	-1.5

*: A negative number indicate a better result by the multi-channel than interference created by DTV.

Table 7.6 Comparison between interference created by DTV and PS Multi-channel for Test Scenario D.

Parameters	Value for Canada D/U (dB)	Multi-channel Tests Results D/U (dB)	Difference (dB) *	Difference with Correction Factors * (dB)
Co-Channel DTV into NTSC	**33.8**	38.8	5.0	-0.2
Lower adjacent channel DTV into NTSC	**-16**	-9.2	6.8	**1.6****
Upper adjacent channel DTV into NTSC	**-12**	-6.2	5.8	**0.6****
Lower adjacent channel DTV into DTV	**-27**	-29.9	-2.9	-8.1
Upper adjacent channel DTV into DTV	**-27**	-21.9	5.1	-0.1

*: A negative number indicate a better result by the multi-channel than interference created by DTV.
**: The multi-channel result doesn't meet the parameter requirement for the interference created by DTV.

Table 7.7 Comparison between interference created by DTV and PS Multi-channel for Test Scenario E.

Parameters	Value for Canada D/U (dB)	Multi-channel Tests Results D/U (dB)	Difference (dB) *	Difference with Correction Factors * (dB)
Co-Channel DTV into NTSC	**33.8**	37.2	3.4	-6.1
Lower adjacent channel DTV into NTSC	**-16**	-4.8	11.2	**1.7****
Upper adjacent channel DTV into NTSC	**-12**	-14.8	-2.8	-12.3
Lower adjacent channel DTV into DTV	**-27**	-24.7	2.3	-7.2
Upper adjacent channel DTV into DTV	**-27**	-23.7	3.3	-6.2

*: A negative number indicate a better result by the multi-channel than interference created by DTV.
**: The multi-channel result doesn't meet the parameter requirement for the interference created by DTV.

Table 7.8 Comparison between interference created by DTV and PS Multi-channel for Test Scenario F.

Parameters	Value for Canada D/U (dB)	Multi-channel Tests Results D/U (dB)	Difference (dB) *	Difference with Correction Factors * (dB)
Co-Channel DTV into NTSC	**33.8**	37.0	3.2	-5.0
Lower adjacent channel DTV into NTSC	**-16**	-4.0	12.0	**3.8****
Upper adjacent channel DTV into NTSC	**-12**	-12.0	0	-8.2
Lower adjacent channel DTV into DTV	**-27**	-26	1.0	-7.2
Upper adjacent channel DTV into DTV	**-27**	-22	5.0	-3.2

*: A negative number indicate a better result by the multi-channel than interference created by DTV.
**: The multi-channel result doesn't meet the parameter requirement for the interference created by DTV.

Table 7.9 Comparison between interference created by DTV and PS Multi-channel for Test Scenario G.

Parameters	Value for Canada D/U (dB)	Multi-channel Tests Results D/U (dB)	Difference (dB) *	Difference with Correction Factors * (dB)
Co-Channel DTV into NTSC	**33.8**	38.5	4.7	-4.8
Lower adjacent channel DTV into NTSC	**-16**	-10.5	5.5	-4.0
Upper adjacent channel DTV into NTSC	**-12**	-3.5	8.5	-1.0
Lower adjacent channel DTV into DTV	**-27**	-31.5	-4.5	-14.0
Upper adjacent channel DTV into DTV	**-27**	-19.0	8.0	-1.5

*: A negative number indicate a better result by the multi-channel than interference created by DTV.

Table 7.10 Comparison between interference created by DTV and PS Multi-channel for Test Scenario H.

Parameters	Value for Canada D/U (dB)	Multi-channel Tests Results D/U (dB)	Difference (dB) *	Difference with Correction Factors * (dB)
Co-Channel DTV into NTSC	**33.8**	38.4	4.6	-3.6
Lower adjacent channel DTV into NTSC	**-16**	-6.6	9.4	**1.2****
Upper adjacent channel DTV into NTSC	**-12**	-6.6	5.4	-2.8
Lower adjacent channel DTV into DTV	**-27**	-28.3	-1.3	-9.5
Upper adjacent channel DTV into DTV	**-27**	-21.3	5.7	-2.5

*: A negative number indicate a better result by the multi-channel than interference created by DTV.
**: The multi-channel result doesn't meet the parameter requirement for the interference created by DTV.

For these cases the results show that the PS interference into DTV or NTSC meets or exceeds the Canadian DTV parameters even for the lower adjacent channel PS interfering into NTSC. For Scenario D the Canadian DTV parameters would not be met, not only for lower adjacent, but also for upper adjacent channel PS interference into NTSC.

For the case of co-channel PS multi channel interference into DTV and NTSC, the D/U results are within 2 dB of the Canadian DTV co-channel parameters. The Canadian DTV co-channel parameters may therefore, be used when considering co-channel multi channel PS into DTV or NTSC.

8 Conclusions

The single channel and multi channel test results have been presented in the figures found in section 6 and section 7 respectively and also in detail tabular from in appendix 5. The conclusions of this study may be summarized as follows:

The PS single channel test results show the following:

- Co-channel PS single channel Interference into DTV

  1 Under co-channel conditions, a D/U of at least 15 dB is required in general for DTV threshold performance over most of the channel bandwidth. However, placing PS channels in the vicinity of the DTV pilot and modulation carrier frequency (around PS channel 480) will require about 5 dB more protection.

  2 About 6 to 10 dB less protection is required if the PS channels are placed within the DTV receiver's notch filter bandwidth[12].

- Adjacent channel PS single channel Interference into DTV

  For Adjacent Channel Interference, the results show that a modest amount of upper and lower guard[13] band would provide enough protection at the grade B equivalent contour of a DTV station if the transmitters were co located[14].

  - For the upper adjacent PS channel about 200 kHz of guard band taken inside PS channels 63/68 would provide a D/U better than –20 dB in the DTV.

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[12] It is noteworthy that not all DTV receivers have notch filters implemented, as this is not mandatory in the specifications. Also, it is expected that this filter will not be implemented anymore once the NTSC system is turned down.

[13] This guard band is assumed to be removed from the PS channel bandwidth (inside channels 63 and 68), so that adjacent TV channels are not affected.

[14] Co located means a PS transmitter at the same location of the TV transmitter or with in a radius of up to 8 km from the TV transmitter.

- For the lower adjacent channel, about twice as much guard band may be required.

- Co-channel PS single channel Interference into NTSC

  Single channel results for NTSC show the requirement for a D/U of about 50 dB for good NTSC performance. A few dB of additional protection will be needed around the NTSC visual, chroma and audio carriers.

- Adjacent channel PS single channel Interference into NTSC

  For Adjacent Channel Interference, the results show that around 200 kHz of upper and lower guard band would allow for a D/U better than 0 dB into the NTSC channel. This would provide enough protection at the grade B equivalent contour of a NTSC station if the transmitters were co located[3].

PS Multi Channel Test Results.

- Co-channel PS multi channel Interference into DTV and Adjacent channel PS multi channel Interference into DTV.

  The D/U requirement is similar to a DTV co-channel interferer, for co-channel PS signals and DTV adjacent channel interferer, for adjacent channel PS signals when 22 to 24[15] PS channels are used i.e. PS can be treated as an equivalent DTV signal.

[15] These are the maximum numbers of narrowband and wideband channels combinations allowed under practical implementation scenario for any one combiner. For a lessor number of channels, a correction factor will have to be applied to the current results.

- Co-channel PS multi channel Interference into NTSC

  The D/U requirement is similar to a DTV co-channel interferer when 22 to 24 PS channels are used i.e. PS can be treated as an equivalent DTV signal.

- Adjacent channel PS multi channel Interference into NTSC

  1. For lower adjacent channel, the D/U requirement is similar to a DTV adjacent channel interferer when 22 to 24 PS channels are used i.e. PS can be treated as an equivalent DTV signal.

  2. For the upper adjacent channel, in some cases, PS was up to 5 dB worse than an equivalent DTV signal. This is because, in this case, the PS signal is close to the NTSC video carrier, and the NTSC signal sensitivity to the interference is frequency dependent.

In the case of interference to NTSC, it should be mentioned that the NTSC threshold is rather softly defined. The threshold was defined as an ITU Grade 3 picture (slightly annoying). Even a value of 5 dB below the adjacent channel threshold will not cause a signal drop out, but only a loss of around 0.5 ITU grade. Therefore, in the case of multi channel systems, for planning purposes, the PS multi carrier system may be treated as a DTV system since, within the margin of experimental error, the DTV Canadian planning parameters are either met or exceeded by the multi channel PS results.

The requirement for less guard band in the case of the NTSC signal in the single channel case may be attributed to better filtering in the NTSC tuner than the DTV set top box.

9 Recommendation For Future Work.

DTV and NTSC test were conducted either with the minimum number of channels i.e. one channel or the maximum number of carriers i.e. 22 channels to 24 channels. CRC would have liked to provide additional multi channel results where the number of channels would be increased in blocks of two or four channels at a time. Also, only one DTV and NTSC receiver was used in the test although CRC would have liked to duplicate the test with several receivers from various manufacturers. The tests with more PS channels and additional DTV and NTSC revivers could not be accomplished because of a lack of time.

It is, therefore, recommended, that additional laboratory tests be conducted to determine the interference to TV as the number of multi channel signals are increased gradually in blocks of two or four channels at a time and also as different DTV and NTSC receiver are used.

All the tests were done using signals generated by software files transferred to an Arbitrary Function Generator. The tests results should be confirmed by repeating some of the measurements using interference signals generated by real PS transmission equipment. For example, in some tests, the upper channels of the multi-channel tests signal were higher than the lower ones. The reason is still unclear, and may have had an impact on these test results although within the margin of experimental error. This anomaly may not be found with real PS equipment.

Further laboratory test should be conducted to verify (once PS equipment becomes commercially available in the 700 MHz band) that similar results will be obtained by a practical implementation as was obtained by simulation of the PS signals.

Finally, field test, should be done to confirm that the results obtained in the laboratory are still valid under operational conditions.

Appendix 1 - Term of Reference

PROPOSAL FOR AN ASSESSMENT OF INTERFERENCE POTENTIAL AND THE DEVELOPMENT OF INTERFERENCE PROTECTION CRITERIA BETWEEN LAND MOBILE AND PUBLIC SAFETY OPERATIONS IN TV CHANNELS 60-69 (746-806 MHz)

2.1 Background

As part of the development of spectrum policy proposals to designate a modest portion of spectrum for mobile services such a public safety in television broadcasting channels 63-64 and 68-69, Industry Canada is seeking to assess the interference potential between broadcasting and mobile services and establish appropriate interference protection criteria to enable the two services to share spectrum and co-exist in these channels in the range of 700 MHz on an interference-free basis. This assessment could assist the Department in determining the means and conditions under which public safety services could use a modest amount of spectrum in these channels without negatively impacting the roll out of digital television in Canada.

The spectrum policy proposals for the use of a modest amount of spectrum by public safety services in the previously-mentioned television channels, follows the process of several stages of public consultation which the Department has started with the June 2001 release of the Proposal to Introduce the Mobile Service on a Co-primary Basis with the Broadcasting Service in the Frequency Band 746-806 MHz (Notice No. DGTP-004-01).

An engineering assessment of which portions of television channels 63-64 and 68-69 could be used for public safety use has been completed. Assessments of how such use could be effectively implemented in now required (ie. Sharing of Mobile with Broadcasting, Broadcasting with Mobile and Mobile with Mobile services).The following will deal with an assessment of interference from Mobile to Broadcasting service.

2.2 Objective

To better understand the potential for interference generating from the land mobile service to the broadcasting service in the range of 700 MHz and to establish appropriate interference protection criteria for broadcasting from mobile to enable these two services to co-exist in this spectrum without having any impact on existing analogue television service and creating any constraint in the roll out of digital television services

2.3 Approach

The study, which will assess the potential for interference from the mobile service to the broadcasting service in the range of 700 MHz, will include the following, but not limited to:

1) Use sound and accepted engineering interference concepts and mitigation techniques for the radio systems and services involved;

2) Respect the technical criteria established for digital television services in Broadcasting Procedures and Rules and in the DTV Transition Allotment Plan;

3) Consider the technical models and approaches adopted by the U.S.; and

4) Consider all other practical and understandable technical concepts to establish practical interference protection criteria that will withstand the rigors of peer review, public scrutiny and future public interventions.

2.4 Scope of Work

i) Define the characteristics of systems involved, develop the engineering concept used to assess the potential for interference in the following scenarios:

- Transmitter interference from mobile base stations and mobile terminals to analogue and digital broadcasting facilities (ie broadcast receivers at cable head-end and at residence)

- Television receiver (analogue and digital) susceptibility to interference from mobile base stations and terminals.

ii) Develop and deliver an engineering brief describing the assumption, that can accurately predict the potential interference in those scenarios listed in section i).

iii) Establish and recommend interference protection criteria that would

- permit the interference free operation of broadcasting service on the designated frequency bands in the case of introduction of mobile service
- provide a clear result of the amount of spectrum that would be free to be used taking into account the established criteria and any guard band spectrum that may need allow such use.

2.5 Schedule

Project initiation: October 15, 2002
Outline: November 1, 2002
First Draft: December 15, 2002
Final Draft: January15, 2003

Appendix 2 - Spurious Emission Measurement Method (FCC Part 90.543)

a) *ACCP measurement procedure.* The following are procedures for making transmitter measurements. For time division multiple access (TDMA) systems, the measurements are to be made under TDMA operation only during time slots when the transmitter is on. All measurements must be made at the input to the transmitter's antenna. Measurement bandwidth used below implies an instrument that measures the power in many narrow bandwidths (e.g. 300 Hz) and integrates these powers across a larger band to determine power in the measurement bandwidth.

1) *Setting reference level.* Using a spectrum analyzer capable of ACCP measurements, set the measurement bandwidth to the channel size. For example, for a 6.25 kHz transmitter, set the measurement bandwidth to 6.25 kHz; for a 150 kHz transmitter set the measurement bandwidth to 150 kHz. Set the frequency offset of the measurement bandwidth to zero and adjust the center frequency of the spectrum analyzer to give the power level in the measurement bandwidth. Record this power level in dBm as the ''reference power level''.
2) *Measuring the power level at frequency offsets <600kHz.* Using a spectrum analyzer capable of ACCP measurements, set the measurement bandwidth as shown in the tables above. Measure the ACCP in dBm. These measurements should be made at maximum power. Calculate the coupled power by subtracting the measurements made in this step from the reference power measured in the previous step. The absolute ACCP values must be less than the values given in the table for each condition above.
3) *Measuring the power level at frequency offsets >600kHz.* Set a spectrum analyzer to 30 kHz resolution bandwidth, 1 MHz video bandwidth and sample mode detection. Sweep ±6 MHz from the carrier frequency. Set the reference level to the RMS value of the transmitter power and note the absolute power. The response at frequencies greater than 600 kHz must be less than the values in the tables above.
4) *Upper power limit measurement. The* absolute coupled power in dBm measured above must be compared to the table entry for each given frequency offset. For those mobile stations with power control, these measurements should be repeated with power control

at maximum power reduction. The absolute ACCP at maximum power reduction must be less than the values in the tables above.

5) *Out-of-band emission limit.* On any frequency outside of the frequency ranges covered by the ACCP tables in this section, the power of any emission must be reduced below the unmodulated carrier power (P) by at least 43 + 10 log (P) dB.

Appendix 3 - Background Information relevant to the Development of the Test Plan

A3.1 Test Parameters.

One approach in studying the effect of PS interference on DTV and NTSC signals is to collect the FCC rules and regulations regarding co-existence in the upper 700 MHz band, including the power and emission limits. These parameters are used as a guide for the development of a test plan for the Canadian study. To this end, the following information is presented.

For the case of PS operating in the 700 MHz band, equipment will be only available in a digital format. There will be no interim period for which analog mobile services will be offered in this band. The CRC study will provide inputs regarding co-channel and adjacent channel interference, which should help in the Canadian band development with respect to guard bands, number of allowable channels that foster co-existence etc. taking into account an all digital PS mobile system implementation.

The parameters used in the CRC study has been extracted as they pertain to the Public Safety band from the public literature and publicly available standards. The following parameters are those required in order to facilitate the development of a test plan for the project. In this regard a study was made of the proposed US band plan, required spectrum efficiency, base station transmitter power, and emission limits.

To provide some background, digital equipment specified in Project 25 for public safety now being used in the 800 MHz in Canada may also be modified for used in the 700 MHz band to allow for immediate deployment in the US and possibly Canada. This equipment uses mostly 12.5 kHz for voice and data in a FDMA system format. Future equipment for voice will only be available for a 6.25 kHz voice channel.

The technical specifications for transmitters designed for voice operation within a 12.5 kHz or 6.25 kHz bandwidth should conform to the ANSI/TIA/EIA102.BAAA-1 common air interface standard and the ANSI/TIA/EIA102.BABA for the vocoder. Transmitters designed for data transmission within a 12.5 kHz or 6.25 kHz bandwidth should conform to 5 standards. The ANSI/TIA/EIA 102.BAEA provides the data overview, the ANSI/TIA/EIA 102.BAEB provides for the packet data specification, the ANSI/TIA/EIA102.BAEC for circuit data description, the ANSI/TIA/EIA 102.BAEA radio control protocol and again the ANSI/TIA/EIA 102.BABA for the vocoder.

The protection for NTSC / DTV broadcasters in this band near the border is the subject of Canadian and US agreements and the responsibility of Industry Canada elsewhere in Canada. In the interim, mobile radio services in the US and possibly in Canada may proceed to operate in channels 63/64, 68/69 on a non-interfering basis.

The information provided regarding the parameters of interest to the TV/mobile radio study will be extracted from the publicly available documents on the FCC web site and any ANSI and or TIA standards that are available for free public viewing.

A3.2 Band Plan in the US

The band plan as adopted by the US for the 700 MHz spectrum is shown in Figure A3.1 The spectrum designated for Commercial Mobile Radio Services (CMRS) and the Public Service (PS) are flanked by two pairs of guard bands 1 MHz and 2 MHz wide respectively. The FCC will most likely auction the CMRS spectrum. The spectrum designated for PS is excluded from the auctioning process and is that it has further broken down for narrowband and wideband services.

For narrowband services such as integrated low speed data and voice, four blocks/segments of 3 MHz have been designated. Figure A3.1 only shows the lower PS block details. This segmentation also applies to the upper PS block. In these blocks, the smallest designated bandwidth allotment is 6.25 kHz. The FCC will allow the combination of up to 4 of these blocks contiguously thus allowing for services to be offered in this band using 6.25 kHz, 12.5 kHz, and 25 kHz bandwidth.

For the case of the wideband services i.e. high-speed data and video, two blocks/segments of 6 MHz have been allocated for wideband use. These blocks have been inserted between each of two 3 MHz narrowband blocks in order to reduce further any possible ACI outside the PS band. Here, also, a similar approach has been taken with the smallest service building block of 50 kHz being designated. Combinations of up to 3 of these blocks are possible allowing for services to be offered in 50 kHz, 100 kHz, and 150 kHz, bandwidth allotments.

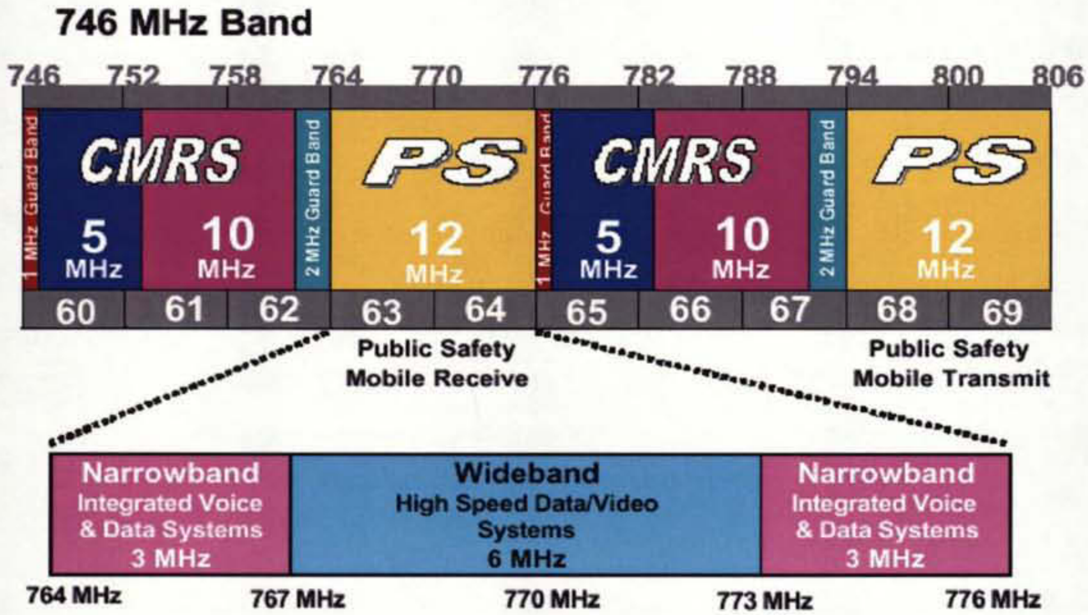


Figure A3.1 – US National Band Plan for Digital Wireless Services in 700 MHz Band

Referring to Figure A3.1 again, the lower PS block (764 MHz to 776 MHz) may be used for mobile, repeaters, and base transmission while the upper block (794 MHz to 806 MHz) may be used only for mobile and fixed (control Station) transmission. For channel pairing purposes, each block is divided in two halves with the lower half of the lower block being paired with the lower half or the upper block etc. Thus from a TV channel standpoint, channel 63/68 and 64/69 are paired. Regarding the number of channels, each narrowband segment (3 MHz) may have up to 480 channels while each wideband segment (6 MHz) up to 120 channels.

An additional impact that the US band plan may have on Canadian TV is the effect of interference on the remaining 8 Canadian TV channel i.e. 60 – 62, 64-67 and 69 in the upper UHF band. It is expected that all these channels will be impacted by interference originating from US mobile radio operation particularly close to the US border. For example, channel 62 would receive interference from the US Guard Band transmitters in the upper 2 MHz of its spectrum, and also interference from the US CMRS transmitters in the remaining 4 MHz of its spectrum etc.

A3.3 Spectrum Efficiency[16]

The FCC has provided guidelines to manufactures and the standard bodies as to the efficient use of the PS spectrum. They require that for narrowband transmitters, a minimum of 4.8 kbps throughput in each 6.25 kHz of bandwidth be achieved. For example, if a 12.5 kHz channel is used, then it would be required to carry at least 9.6 kbps of data, and so on. For the wideband segment, they opted to specify the efficiency for the largest possible block of 150 kHz. In that bandwidth, they require a minimum bit rate of 384 kbps to be passed. In this case each 50 kHz block would be required to carry at least 128 kbps of data. For the given specifications, 2 level modulation such as BPSK and higher would satisfy the narrowband case while the wideband stipulation could be satisfied with 8 state modulation such as 8 PSK and higher.

A3.4 Transmitter Power[17] & Emission Limits[18]

In order to have all the relevant parameters in one place, Table A3.1 has been provided. This table shows the transmitter power and emission limits for scenarios before and after the December 31 2006 deadlines for TV channel vacation of this band. It also assumes that TV channel 63 in the lower band of the PS spectrum is the channel under study and will be used in a later section to provide the possible interference sources from the surrounding mobile systems into TV.

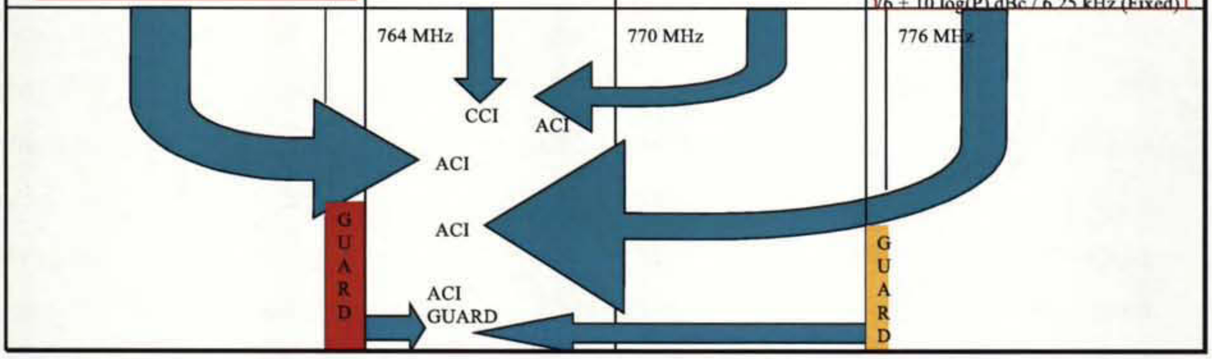
[16] See FCC 47 C.F.R §90.535 (Modulation and spectrum usage efficiency requirements)

[17] See FCC 47 C.F.R §90.541 (Transmitting power limits).

[18] See FCC 47 C.F.R §90.543 (Emission limitations).

Table A3.1 Power and Emission Limits for 700 MHz Lower PS into TV Ch. 63

CMRR		PS	PS		CMRR
CHAN 60 / CHAN 61 / CHAN 62		CHAN 63 **NT / DTV Rx**	CHAN 64 **NTSC / DTV Rx**		CHAN 65 / CHAN 66 / CHAN 67
Base Tx / Rx 1 kW Fixed (Repeater) Tx 1 kW	G B	Base & Fixed (Repeater) Tx 1 kW (Urban), 500W (Sub-urban), Mobile 30 W,	Base & Fixed (Repeater) Tx 1 kW (Urban), 500W (Sub-urban), Mobile 30 W	G B	Fixed (Control) Tx 30 W Mobile Tx / Rx 30 W Portable Tx 3 W
Before December 31 2006 Allowable ACI into TV from CMRR D/U=0dB at NTSC Grade B (64 dBμV/m) D/U = -23 dB at DTV Grade B (41 dBμV/m)		**Before December 31 2006** from PS Allowable CCI into TV D/U = 40dB at NTSC Grade B, (64 dBμV/m) & 17 dB at DTV Grade B (41dBμV/m)	**Before December 31 2006** from PS Allowable ACI into TV D/U = 0 dB at NTSC Grade B, (64 dBμV/m) & -23 dB at DTV Grade B (41 dBμV/m)		**Before December 31 2006** Allowable ACI into TV from CMRR D/U=0dB at NTSC Grade B (64 dBμV/m) D/U = -23 dB at DTV Grade B (41 dBμV/m)
After December31 2006 76 + 10 log(P) dBc / 6.25 kHz -61 dBm / 6.25 kHz 43 + 10 log(P) dBc or 80 dBc at any frequency		**After December 31 2006** See emission tables	**After December 31 2006** See emission tables		**After December 31 2006** 65 + 10 log(P) dBc / 6.25 kHz (M & P) 43 + 10 log(P) dBc or 80 dBc at any frequency 76 + 10 log(P) dBc / 6.25 kHz (Fixed)



A3.4.1 Transmitter Power Limit.

A3.4.1.1 CMRS and Guard Band Transmitters

Starting with the transmitters, the table shows that Base station and fixed (repeater) transmitter power is limited to 1 kW ERP and an HAAT of 305 meters in the B and C blocks of the CMRS band. (These blocks could be used for example by cellular operators to provide UMTS digital services where paired bandwidth about 5 MHz is required). However, base stations and repeaters operating in this band are only authorized to transmit in the lower CMRS block. (747 MHz to 762 MHz). This base station transmitter rule also applies to transmissions in the guard bands above this lower CMRS block thus extending the CMRS power limitation out to 764 MHz. (paging transmitters is a typical type of service that could be offered in this guard band spectrum). The guard band blocks above the lower CMRS band is of interest in this study. Protected NTSC/DTV channels 60 through 62 currently occupy these blocks.

Similarly the upper CMRS (777 MHz to 792 MHz) block is designated for the use of the related fixed (control), and mobile transmitters that are limited to 30W ERP. Portable stations also operate in this band and are limited to 3 W ERP. In this case both guard bands flanking the block are also allowed to have mobile and control stations. Also allowed are hand held devices that are limited to a maximum ERP of 3 W. Here again, protected NTSC/DTV channels 65 through 67 currently occupy this upper CMRS block.

From the standpoint of NTSC / DTV channel 63, all the transmitters discussed above are a source of adjacent channel interference.

A3.4.1.2 Public Safety Band Transmitters

Within the public safety band each block (lower and upper) has been divided into two 6 MHz sub-blocks occupying the same band as TV channel 63 and channel 64 in the lower PS block and channels 68 and 69 in the upper PS block. Nevertheless, the same power and emission limits apply equally in all sub-blocks. In this study, interest is only in the lower PS block occupied by protected TV channel's 63 and 64. Referring to the table A3.1, the FCC has classified transmitters in the PS band, into two classes[19], either urban or sub-urban. For the case of the urban base station transmitters a 1 kW ERP at 304 m HAAT is allowed. For the sub-urban base station transmitters, a power of 500 W ERP is allowed at an HAAT of 152 m. Mobile transmitters, which are limited to 30 W ERP are also allowed. Cities close to the Canadian border that are classified as Urban are Buffalo N.Y and Detroit Michigan. All other cities close to the Canadian border are considered to be sub-urban. Since the 1 kW case is the worst case, it has been highlighted in the summary table. This will create the worst case interference in the Canadian NTSC / DTV system.

Transmitters operating in the lower sub-block of the PS band provide a source of co-channel interference to Channel 63 while transmitters operating in the upper sub-block (equivalent to channel 64) provide another source of adjacent channel interference to TV channel 63.

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[19] FCC rules and regulations Part §90.635

In the public safety band, the transmitter power is on a per carrier basis. Thus for example, if 5 channels are operating in an urban area base station, 5 kW of power will be allowed etc. the above presentation of transmitter power in the various bands is for information only and will not be used in absolute terms in the study. They may be of interest when used in conjunction with the D/U ratios during the rule making process.

A3.4.2 Emission Limits

Table A3.1 shows that the CMRS emission limits may be specified either by levels with respect to the transmitter carrier power i.e. dBc or by tables provided by the FCC. Noteworthy is that the limits pertaining to both the PS band and the guard bands are specified in tables and are the same values. For the case of the lower and upper CMRS bands, limits are specified in dBc.

A3.4.2.1 Emission Limits in the CMRS Band.

The table A3.1 also shows that for the case of the CMRS blocks, base station and fixed transmitters in the lower block are limited to out of band transmissions as follows:

- A minimum of 43 + 10 log (P) dBc or 80 dBc below that transmitter unmodulated carrier power (P) whichever is lower, at any out of band frequency.
- In any 6.25 kHz segment in the PS band, 76 + 10 log (P) dBc / 6.25 kHz band

For the upper CMRS block, the same rules as above apply for fixed stations, additionally in this block mobiles and portable stations also operate. For those, the following limits apply:

- A minimum of 43 + 10 log (P) dBc or 80 dBc below that transmitter power (P) whichever is lower, at any frequency.
- In any 6.25 kHz segment in the PS band, not less than 65 + 10 log (P) dBc / 6.25 kHz

A3.4.2.2 Emission Limits in the Guard and Public Safety Bands.

With respect to channel 63, the guard band on either side of the lower PS block (764 – 776 MHz need only be considered. Therefore, the emission limits in the tables that follow apply to all transmitters in the band from 762 MHz to 777 MHz. For the purpose of this study, the interference from upper guard band and PS transmitters may be considered negligible since they originate at N+5.

The following tables present the emission limits for base station and mobile transmitters occupying 6.25 kHz, 12.5 kHz and 25 kHz bandwidth.

Table A3.2 – 6.25 kHz Mobile Transmitter ACCP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACCP relative (dBc)	Maximum ACCP absolute (dBm)
6.25	6.25	-40	not specified
12.50	6.25	-60	-45
18.75	6.25	-60	-45
25.00	6.25	-65	-50
37.50	25.00	-65	-50
62.50	25.00	-65	-50
87.50	25.00	-65	-50
150.00	100.00	-65	-50
250.00	100.00	-65	-50
>400 to receive band	30(s)	-75	-55
In the receive band	30(s)	-100	-70

Table A3.3 – 12.5 kHz Mobile Transmitter ACCP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACCP relative (dBc)	Maximum ACCP absolute (dBm)
9.375	6.25	-40	not specified
15.625	6.25	-60	-45
21.875	6.25	-60	-45
37.500	25.00	-65	-50
62.500	25.00	-65	-50
87.500	25.00	-65	-50
150.000	100.00	-65	-50
250.000	100.00	-65	-50
>400 to receive band	30(s)	-75	-55
In the receive band	30(s)	-100	-70

Table A3.4 – 25 kHz Mobile Transmitter ACCP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACCP relative (dBc)	Maximum ACCP absolute (dBm)
15.625	6.25	-40	not specified
21.875	6.25	-60	-45
37.500	25.00	-65	-50
62.500	25.00	-65	-50
87.500	25.00	-65	-50
150.000	100.00	-65	-50
250.000	100.00	-65	-50
>400 to receive band	30(s)	-75	-55
In the receive band	30(s)	-100	-70

Table A3.5 – 150 kHz Mobile Transmitter ACCP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACCP relative (dBc)	Maximum ACCP absolute (dBm)
100	50	-40	not specified
200	50	-50	-35
300	50	-50	-35
400	50	-50	-35
600 to 1000	30(s)	-60	-45
1000 to receive band	30(s)	-70	-55
In the receive band	30(s)	-100	-75

Table A3.6 – 6.25 kHz Base Transmitter ACCP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACCP (dBc)
6.25	6.25	-40
12.50	6.25	-60
18.75	6.25	-60
25.00	6.25	-65
37.50	25.00	-65
62.50	25.00	-65
87.50	25.00	-65
150.00	100.00	-65
250.00	100.00	-65
>400 to receive band	30(s)	-80 (continues @-6dB/oct)
In the receive band	30(s)	-100

Table A3.7 – 12.5 kHz Base Transmitter ACCP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACCP (dBc)
9.375	6.25	-40
15.625	6.25	-60
21.875	6.25	-60
37.500	25.00	-60
62.500	25.00	-65
87.500	25.00	-65
150.000	100.00	-65
250.000	100.00	-65
>400 to receive band	30(s)	-80 (continues @-6dB/oct)
In the receive band	30(s)	-100

Table A3.8 – 25 kHz Base Transmitter ACCP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACCP (dBc)
15.625	6.25	-40
21.875	6.25	-60
37.500	25.00	-60
62.500	25.00	-65
87.500	25.00	-65
150.000	100.00	-65
250.000	100.00	-65
>400 to receive band	30(s)	-80 (continues @-6dB/oct)
In the receive band	30(s)	-100

Table A3.9 – 150 kHz Base Transmitter ACCP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACCP (dBc)
100	50	-40
200	50	-50
300	50	-55
400	50	-60
600 to 1000	30(s)	-65
1000 to receive band	30(s)	-75 (continues @-6dB/oct)
In the receive band	30(s)	-100

The mobile tables also apply to portable and hand held devices. Tables are also provided for 50 kHz, 100 kHz and 150 kHz transmitters. They show the allowable Adjacent Channel Coupled Power (ACCP) in relative and absolute power values. These values are based on the channel width of the transmissions at a given offset from the center frequency.

Associated with the tables are sets of measurement procedures. The procedures have been included in Appendix 2 to facilitate the laboratory measurements should they be needed.

Each signal used in the study was tested and verified to confirm to the bandwidth and emission limits stated in the tables A3.2 to A3.9 above.

A3.5 NTSC / DTV Interference Scenarios for Channel 63 in the Public Safety Band.

Referring again to table A3.1, the table shows that those sources of interference into TV channel 63 as follows:

- Adjacent Channel Interference from the lower CMRS.
- Adjacent Channel Interference from the lower Guard Band.
- Co-Channel Interference from the PS operating from within channel 63.
- Adjacent Channel Interference from upper half of the PS occupying TV channel 64.
- Adjacent Channel Interference from the Upper Guard Band.
- N+2 Interference from the upper CMRS.

The interference is generated from the various base stations, fixed stations, control stations, mobile and portable stations that may be in operation at a particular time. ACI from the CMRS band most likely will originate from wide band services such as Digital cellular GSM/GPRS/GERAN, UMTS, and CDMA 2000. Guard band ACI may be introduced from paging transmitters operating in that band. However, no cellular type services are allowed in the guard band because of their proximity to the PS band. CCI into channel 63 may originate from a combination of narrowband (up to 25 kHz bandwidth) in the lower 3 MHz of channel 63 or wideband (up to 150 kHz bandwidth) transmitters in the upper 3 MHz of channel 63. ACI from similar wideband and narrowband transmitters in the upper sub-block of the lower PS band in the equivalent bandwidth as occupied by TV channel 64. In this band mobile radios to support systems such as school bus radio systems, emergency service such as ambulance, fire, police etc may be found. Transmissions in the upper guard band such, as pagers etc. is another source of ACI. With respect to the upper CMMR band, ACI from mobile, portable and control station transmitters may have minimal effect on channel 63 as a result of N+2 frequency separation. Clearly, it is not possible to evaluate the impact of all possible combinations of the interference sources. Some manageable sub-set typical of the environment will have to be selected. Farther away from the US border, the situation is not as complex within interference sources being only from the PS operating in channels 63 and 69.

A3.6 NTSC / DTV Protection.

In the US protection for NTSC and DTV television operation in the PS band is extended to December 31 2006. Thus allows time for operators to convert to DTV and vacate the band. Protection for both NTSC and DTV is based on separation distances between land mobile radio sites and NTSC / DTV transmitters. The separation distances are calculated such that for a broadcasting NTSC TV station a D/U signal ratio of 40 dB or greater is obtained at the grade B contour for CCI and a D/U ratio of 0 dB is obtained for ACI at the same contour. For the case of a DTV station a D/U of 17 dB for CCI and – 23 dB for ACI or better must be maintained at the station's equivalent grade B contour. Table 3.4.1 provides a summary of the requirements. Public Safety systems may have to either increase their separation distance or reduce their power and emission limits in order to meet these requirements until 2006 after which time they will be guided only by power and emission limits. Canada may need to develop a similar set of rules for channels 63 and 68 during the transition period.

A3.7 Upper PS Block Interference Scenarios.

For the sake of completeness, table A3.10 shows the situation for ACI and CCI for TV channels operating in the upper PS block. Here the affected NTSC/DTV channels are channels 68 and 69. For these channels, the sources of interference to be concerned about are as follows:

- Adjacent Channel Interference from the upper CMRS.
- Adjacent Channel Interference from the upper Guard Band.

- Co-Channel Interference from the PS operating from within channel 68.
- Adjacent Channel Interference from upper half of the PS occupying TV channel 69.
- Adjacent Channel Interference from the land mobile and fixed point-to-point systems occupying the band of 806 MHz to 821 MHz. (N+2)

Table A3.10 Power and Emission Limits for 700 MHz Upper PS into TV Ch. 68

CMRR	PS	PS	Land Mobile
CHAN 65 / CHAN 66 / CHAN 67	CHAN 68 **NT / DTV Rx**	CHAN 69 **NTSC / DTV Rx**	806 MHz to 821 MHz - Public Safety
Fixed (Control) Tx 30 W Mobile Tx / Rx 30 W Portable Tx 3 W (GB)	Mobile 30 W, Control Stations 30 W Portables 3 W	Mobile 30 W, Control Stations 30 W Portables 3 W	MS Tx with Freq. separation of 45 MHz.
Before December 31 2006 Allowable ACI into TV from CMRR D/U=0dB at NTSC Grade B (64 dBμV/m) D/U = -23 dB at DTV Grade B (41 dBμV/m)	**Before December 31 2006** from PS Allowable CCI into TV D/U = 40dB at NTSC Grade B, (64 dBμV/m) & 17 dB at DTV Grade B (41dBμV/m)	**Before December 31 2006** from PS Allowable ACI into TV D/U = 0 dB at NTSC Grade B, (64 dBμV/m) & -23 dB at DTV Grade B (41 dBμV/m)	806 MHz - 809.75 MHz - SMR 809.75 MHz - 816 MHz - Interleaved 816 MHz - 821 MHz - Upper SMR 821 MHz - 824 MHz - Public Safety.
After December31 2006 65 + 10 log(P) dBc / 6.25 kHz -61 dBm / 6.25 kHz 43 + 10 log(P) dBc or 80 dBc at any frequency 76 + 10 log(P) dBc / 6.25 kHz (Fixed)	**After December 31 2006** See emission tables	**After December 31 2006** See emission tables	> 824 MHz - Cellular A & B bands

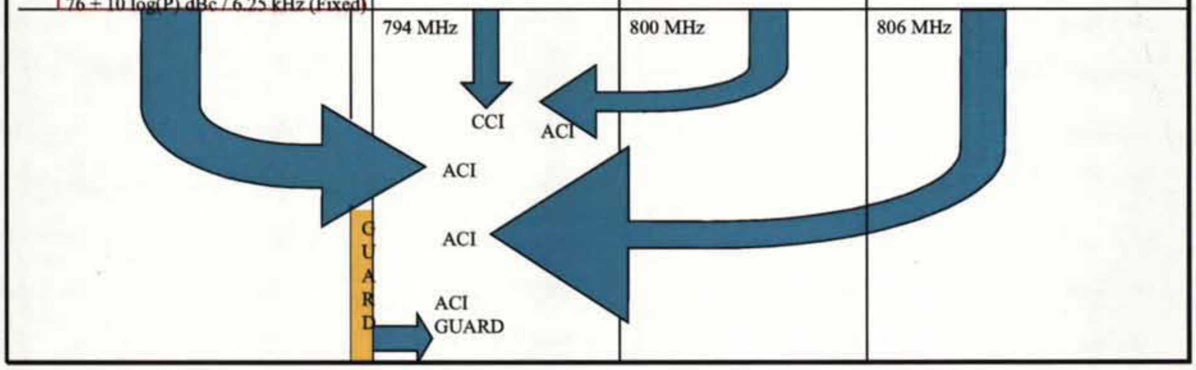

Table A3.10 also shows that the interference sources in this case is originating mostly from the relatively low power mobile, control, portable and in guard band, hand held transmitters below the upper PS band. However, both base station and mobile transmitters operate in the Land Mobile band between 806 MHz and 821 MHz. With respect to emission control, the same rules apply as are outlined in the section on emission above for the frequencies below the 700 MHz PS band. Above the band in the area designated as land mobile, emission limits have not been investigated. Similarly, protection to the TV channels is also guaranteed as above unit December 31 2006. However, it may be concluded that the rules resulting from the study of channel 63 may be applied to channel 68 since the study is based on D/U ratios. Interference levels that are related to channel 68 are expected to be lower.

A3.8 Canada / US Border Region.

Regarding the licensing of PS systems in the 700 MHz band near the Canadian border and the FCC takes the following approach: *"In examining this issue, the Commission typically takes one of two approaches. We either postpone licensing of land mobile stations within a certain geographic distance (e.g., 120-km (75 miles)) of Canada and Mexico, or permit interim authorizations conditioned on the outcome of future agreements. Because international negotiations can take many months or even years to finalize, we wish to take the later approach and adopt certain interim requirements for public safety licenses along the Canada and Mexico borders, providing that the licenses are subject to whatever future agreements the United States develops with the two countries. Nevertheless, existing mutual agreements with Canada and Mexico for the use of these bands for UHF television must be recognized until further negotiations are completed. Additionally, public safety facilities within the United States must accept interference from authorized channel 60-69 TV transmitters in Canada and Mexico in accordance with the existing agreements. Since the locations of the Canadian and Mexican assignments are known for UHF television, the public safety applicants can consider the levels of harmful interference to expect from Canadian and Mexican UHF TV stations when applying for a license. Both Canada and Mexico have been informally notified that the Commission has changed its allocated use of TV channels 60-69, and the Commission will discuss the possibility of mutually compatible spectrum use with Canada and Mexico."*[20]

[20] §166, FIRST REPORT AND ORDERAND THIRD NOTICE OF PROPOSED RULEMAKING Adopted: August 6, 1998

Appendix 4 - Test Plan for the evaluation of the effects of PS interference into TV

A4.1 Background.

The following presents a discussion on the implementation of the TV / PS test bed, test procedures and the test process.

A4.2 Test Plan Objective

TV channel 2 (54 MHz to 60 MHz) will be used for the lab evaluation of both co-channel and adjacent channel interference scenarios from the PS into DTV and NTSC TV channel. The test results will be transposed to the PS band for final presentation. The objectives of the tests are to provide the relevant D/U ratios for the various test scenarios. It is expected that Industry Canada will use these D/U ratios to determine the separation distances between TV and PS facilities. Also in their rule making process for the coexistence of TV and PS system's in the 700 MHz band both before and after the Canadian system transition to an all DTV system.

A4.3 Modulation.

In the narrow band segment, Compatible Quadrate Phase Shift Keying CQPSK (AM QPSK-C) is used for voice, the data channels may use higher modulation. The following is a recommendation for narrow and wideband modulation:

Occupied Bandwidth (kHz)	Recommended Modulation	Excess bandwidth (α %)
6.25	CQPSK / 16 QAM (data)	20
12.5	16 QAM	20
25.0	64 QAM	20
50.0	64 QAM	20
100.0	64 QAM	20
150.0	64 QAM	20

Refer to the emission level specifications in the Guidelines in order to confirm that the limits will be met with 20 % excess bandwidth and modify accordingly

A4.4 Number of Channels Suggested for the Study.

The proposed number of channels to be used in the study was arrived at by discussions with knowledgeable people in the field. It seems that a limiting factor is the number of channels that may be combined without undue distortion. The study, therefore, should incorporate if possible the following number of channels:

Occupied Bandwidth (kHz)	Recommended Number of Channels
193.0	1 – 120
193.0	1 – 60
193.0	1 – 30
193.0	1 – 30
193.0	1 – 20
150.0	1 – 10

A4.5 Sensitivity Evaluation

Before multi-carrier tests are conducted, it is proposed that a single carrier sensitivity test be conducted both for DTV and NTSC. This test should be repeated four times corresponding to each of the above bandwidths / modulations for 6.24 kHz, 5 kHz, 50 kHz, 150 kHz channels. These tests should sweep the band from 500 kHz below TV channels 2 to 500 kHz above channel 2. This test should yield the D/U to TOV for DTV and grade 3 reception for NTSC as a function of channel number / channel Frequency.

A4.6 PS Multi-carrier into DTV & NTSC

It is proposed to populate the test channel with a combination of narrowband and wideband channels in a symmetrical manner or by some worst case formula as may be determined from the sensitivity measurements. This will be carried out for NTSC and DTV, recording for each measurement, the maximum interference to grade 3 / TOV performance.

Similar table as above will be provided for the recommended frequency of measurement for the multi-channel tests once the sensitivity tests are completed.

The number of channels used simultaneously in the test will varies depending on the allowable combining capacity.

A4.7 Desired Sign al Level

Although there are six possible standard desired signal levels, a subset of two of these will be used for the test as follows. All co-channel and adjacent channel tests will be conducted using the “weak” desired signal level. (DTV -68 dBm, and NTSC –55 dB)

A4.8 Measuremen t Test Bed

If possible, the following test bed in figure A4.1 may be set up in order to allow for maximum flexibility during the test.

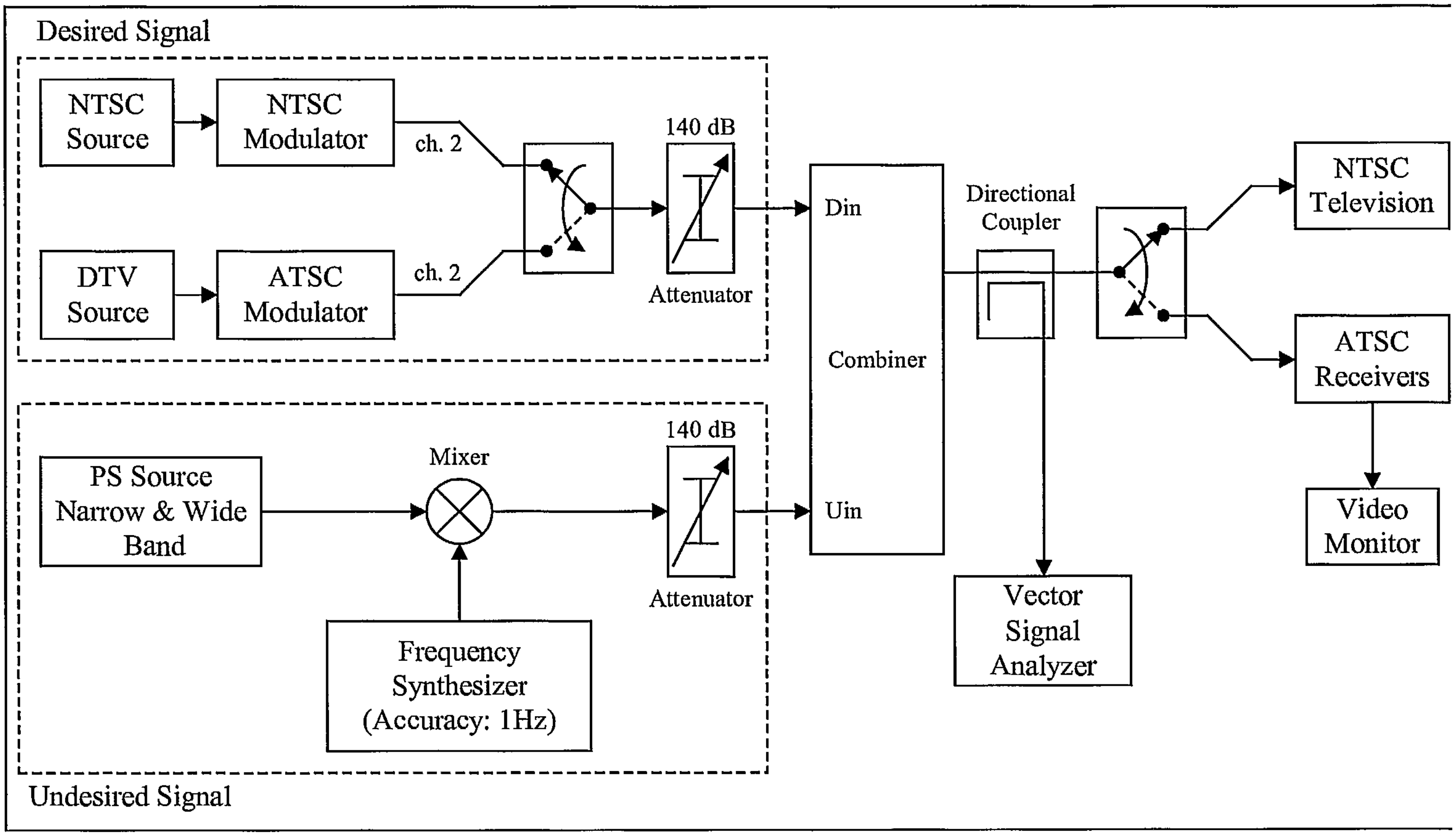

Figure A4.1 Proposed Test Bed: Evaluation of Interference from the PS to TV

There are cases where both narrow band and wide band interferes may be present at the same time. In this instant, both narrow band and wide band generators need to be present on the undesired signal path (Uin). The interference level in the unwanted path (Uin) should also be adjustable in 1.0 dB steps or less.

Appendix 5 - Tabulated Test Results

Table A5.1 Interference from one Narrowband PS Signal (6.25kHz) into DTV

CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
-480	50.996875	180.996875	30.5	**-28**
-450	51.184375	181.184375	31	**-27.5**
-400	51.496875	181.496875	32.5	**-26**
-350	51.809375	181.809375	34	**-24.5**
-300	52.121875	182.121875	34.5	**-24**
-250	52.434375	182.434375	35	**-23.5**
-200	52.746875	182.746875	34.5	**-24**
-150	53.059375	183.059375	33.5	**-25**
-100	53.371875	183.371875	31.5	**-27**
-90	53.434375	183.434375	32	**-26.5**
-80	53.496875	183.496875	32.5	**-26**
-70	53.559375	183.559375	33.5	**-25**
-60	53.621875	183.621875	35	**-23.5**
-50	53.684375	183.684375	36.5	**-22**
-40	53.746875	183.746875	38.5	**-20**
-30	53.809375	183.809375	42.5	**-16**
-20	53.871875	183.871875	46.5	**-12**
-10	53.934375	183.934375	49.5	**-9**
1	54.003125	184.003125	52.5	**-6**
10	54.059375	184.059375	56	**-2.5**
20	54.121875	184.121875	59.5	**1**
30	54.184375	184.184375	62	**3.5**
40	54.246875	184.246875	66.5	**8**
45	54.278125	184.278125	70	**11.5**
47	54.290625	184.290625	71.5	**13**
48	54.296875	184.296875	73	**14.5**
49	54.303125	184.303125	75	**16.5**
50	54.309375	184.309375	78	**19.5**
51	54.315625	184.315625	76	**17.5**
52	54.321875	184.321875	73.5	**15**
53	54.328125	184.328125	72	**13.5**
55	54.340625	184.340625	71.5	**13**
100	54.621875	184.621875	71.5	**13**
175	55.090625	185.090625	73.5	**15**
180	55.121875	185.121875	74	**15.5**
185	55.153125	185.153125	65.5	**7**
200	55.246875	185.246875	65.5	**7**
205	55.278125	185.278125	65.5	**7**
210	55.309375	185.309375	65	**6.5**
215	55.340625	185.340625	65.5	**7**
220	55.371875	185.371875	65.5	**7**
225	55.403125	185.403125	73.5	**15**

250	55.559375	185.559375	74	**15.5**
300	55.871875	185.871875	74.5	**16**
400	56.496875	186.496875	74.5	**16**
477	56.978125	186.978125	74.5	**16**
478	56.984375	186.984375	75	**16.5**
479	56.990625	186.990625	76	**17.5**
480	56.996875	186.996875	78	**19.5**
481	57.003125	187.003125	77	**18.5**
482	57.009375	187.009375	76.5	**18**
483	57.015625	187.015625	75	**16.5**
484	57.021875	187.021875	74.5	**16**
500	57.121875	187.121875	74	**15.5**
600	57.746875	187.746875	73.5	**15**
700	58.371875	188.371875	74.5	**16**
800	58.996875	188.996875	73	**14.5**
862	59.384375	189.384375	72	**13.5**
900	59.621875	189.621875	72	**13.5**
921	59.753125	189.753125	71.5	**13**
930	59.809375	189.809375	67	**8.5**
940	59.871875	189.871875	65.5	**7**
950	59.934375	189.934375	62.5	**4**
960	59.996875	189.996875	60	**1.5**
1000	60.246875	190.246875	54.5	**-4**
1010	60.309375	190.309375	52.5	**-6**
1030	60.434375	190.434375	48.5	**-10**
1060	60.621875	190.621875	42.5	**-16**
1065	60.653125	190.653125	39	**-19.5**
1070	60.684375	190.684375	37.5	**-21**
1073	60.703125	190.703125	37.5	**-21**
1075	60.715625	190.715625	37	**-21.5**
1078	60.734375	190.734375	37	**-21.5**
1080	60.746875	190.746875	37.5	**-21**
1085	60.778125	190.778125	37.5	**-21**
1090	60.809375	190.809375	37.5	**-21**
1100	60.871875	190.871875	38	**-20.5**
1150	61.184375	191.184375	39	**-19.5**
1200	61.496875	191.496875	39.5	**-19**
1250	61.809375	191.809375	39.5	**-19**
1300	62.121875	192.121875	39	**-19.5**
1350	62.434375	192.434375	38.5	**-20**
1400	62.746875	192.746875	39	**-19.5**
1440	62.996875	192.996875	38.5	**-20**

Table A5.2 Interference from one Narrowband PS Signal (6.25kHz) into NTSC

CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ ITUR-3 (dB)	D/U @ ITUR-3 (dB)	Note
-500	50.871875	180.871875	33	**-11.6**	
-485	50.965625	180.965625	33	**-11.6**	
-475	51.028125	181.028125	33	**-11.6**	
-460	51.121875	181.121875	43	**-1.6**	
-450	51.184375	181.184375	37	**-7.6**	
-435	51.278125	181.278125	37	**-7.6**	
-425	51.340625	181.340625	41	**-3.6**	
-410	51.434375	181.434375	44	**-0.6**	
-400	51.496875	181.496875	53	**8.4**	
-385	51.590625	181.590625	53	**8.4**	
-375	51.653125	181.653125	53	**8.4**	
-360	51.746875	181.746875	48	**3.4**	
-350	51.809375	181.809375	42	**-2.6**	
-335	51.903125	181.903125	47	**2.4**	
-325	51.965625	181.965625	43	**-1.6**	
-310	52.059375	182.059375	43	**-1.6**	
-300	52.121875	182.121875	41	**-3.6**	
-285	52.215625	182.215625	36	**-8.6**	
-275	52.278125	182.278125	36	**-8.6**	
-260	52.371875	182.371875	36	**-8.6**	
-250	52.434375	182.434375	38	**-6.6**	
-235	52.528125	182.528125	43	**-1.6**	
-225	52.590625	182.590625	47	**2.4**	
-210	52.684375	182.684375	45	**0.4**	
-200	52.746875	182.746875	42	**-2.6**	
-185	52.840625	182.840625	42	**-2.6**	
-175	52.903125	182.903125	40	**-4.6**	
-160	52.996875	182.996875	37	**-7.6**	
-150	53.059375	183.059375	35	**-9.6**	
-135	53.153125	183.153125	37	**-7.6**	
-125	53.215625	183.215625	37	**-7.6**	
-110	53.309375	183.309375	35	**-9.6**	
-100	53.371875	183.371875	36	**-8.6**	
-85	53.465625	183.465625	39	**-5.6**	
-75	53.528125	183.528125	41	**-3.6**	
-60	53.621875	183.621875	39	**-5.6**	
-50	53.684375	183.684375	36	**-8.6**	
-35	53.778125	183.778125	34	**-10.6**	
-25	53.840625	183.840625	29	**-15.6**	
-10	53.934375	183.934375	30	**-14.6**	
-5	53.965625	183.965625	30	**-14.6**	
1	54.003125	184.003125	40	**-4.6**	
5	54.028125	184.028125	46	**1.4**	
10	54.059375	184.059375	50	**5.4**	
15	54.090625	184.090625	55	**10.4**	

20	54.121875	184.121875	62	**17.4**	
25	54.153125	184.153125	57	**12.4**	
30	54.184375	184.184375	63	**18.4**	
33	54.203125	184.203125	62	**17.4**	
34	54.209375	184.209375	73	**28.4**	
35	54.215625	184.215625	70	**25.4**	
36	54.221875	184.221875	67	**22.4**	
37	54.228125	184.228125	73	**28.4**	
38	54.234375	184.234375	63	**18.4**	
40	54.246875	184.246875	61	**16.4**	
43	54.265625	184.265625	64	**19.4**	
44	54.271875	184.271875	65	**20.4**	
45	54.278125	184.278125	71	**26.4**	
50	54.309375	184.309375	71	**26.4**	
51	54.315625	184.315625	70	**25.4**	
55	54.340625	184.340625	66	**21.4**	
59	54.365625	184.365625	69	**24.4**	
60	54.371875	184.371875	78	**33.4**	
61	54.378125	184.378125	68	**23.4**	
63	54.390625	184.390625	69	**24.4**	
65	54.403125	184.403125	74	**29.4**	
70	54.434375	184.434375	72	**27.4**	
74	54.459375	184.459375	74	**29.4**	
75	54.465625	184.465625	81	**36.4**	
76	54.471875	184.471875	71	**26.4**	
80	54.496875	184.496875	71	**26.4**	
85	54.528125	184.528125	74	**29.4**	
89	54.553125	184.553125	76	**31.4**	
90	54.559375	184.559375	84	**39.4**	
91	54.565625	184.565625	74	**29.4**	
95	54.590625	184.590625	75	**30.4**	
100	54.621875	184.621875	79	**34.4**	
104	54.646875	184.646875	80	**35.4**	
105	54.653125	184.653125	89	**44.4**	
106	54.659375	184.659375	78	**33.4**	
110	54.684375	184.684375	79	**34.4**	
114	54.709375	184.709375	78	**33.4**	
115	54.715625	184.715625	90	**45.4**	
116	54.721875	184.721875	78	**33.4**	
120	54.746875	184.746875	80	**35.4**	
125	54.778125	184.778125	84	**39.4**	
129	54.803125	184.803125	82	**37.4**	
130	54.809375	184.809375	90	**45.4**	
131	54.815625	184.815625	82	**37.4**	
133	54.828125	184.828125	85	**40.4**	
135	54.840625	184.840625	86	**41.4**	
138	54.859375	184.859375	85	**40.4**	
139	54.865625	184.865625	82	**37.4**	
140	54.871875	184.871875	90	**45.4**	

141	54.878125	184.878125	87	**42.4**	
142	54.884375	184.884375	87	**42.4**	
143	54.890625	184.890625	89	**44.4**	
144	54.896875	184.896875	84	**39.4**	
145	54.903125	184.903125	93	**48.4**	
146	54.909375	184.909375	81	**36.4**	
147	54.915625	184.915625	86	**41.4**	
148	54.921875	184.921875	84	**39.4**	
150	54.934375	184.934375	83	**38.4**	
154	54.959375	184.959375	82	**37.4**	
155	54.965625	184.965625	94	**49.4**	
160	54.996875	184.996875	94	**49.4**	
165	55.028125	185.028125	92	**47.4**	
166	55.034375	185.034375	79	**34.4**	
168	55.046875	185.046875	81	**36.4**	
170	55.059375	185.059375	83	**38.4**	
171	55.065625	185.065625	86	**41.4**	
172	55.071875	185.071875	80	**35.4**	
173	55.078125	185.078125	96	**51.4**	
175	55.090625	185.090625	93	**48.4**	
178	55.109375	185.109375	96	**51.4**	
179	55.115625	185.115625	84	**39.4**	
180	55.121875	185.121875	88	**43.4**	
185	55.153125	185.153125	85	**40.4**	
190	55.184375	185.184375	85	**40.4**	
195	55.215625	185.215625	87	**42.4**	
196	55.221875	185.221875	85	**40.4**	
197	55.228125	185.228125	85	**40.4**	
199	55.240625	185.240625	86	**41.4**	
200	55.246875	185.246875	88	**43.4**	Video
201	55.253125	185.253125	87	**42.4**	
202	55.259375	185.259375	87	**42.4**	
203	55.265625	185.265625	98	**53.4**	
205	55.278125	185.278125	95	**50.4**	
206	55.284375	185.284375	95	**50.4**	
208	55.296875	185.296875	98	**53.4**	
209	55.303125	185.303125	92	**47.4**	
210	55.309375	185.309375	92	**47.4**	
220	55.371875	185.371875	91	**46.4**	
230	55.434375	185.434375	92	**47.4**	
240	55.496875	185.496875	92	**47.4**	
245	55.528125	185.528125	89	**44.4**	
250	55.559375	185.559375	87	**42.4**	
260	55.621875	185.621875	87	**42.4**	
265	55.653125	185.653125	89	**44.4**	
270	55.684375	185.684375	91	**46.4**	
280	55.746875	185.746875	89	**44.4**	
290	55.809375	185.809375	89	**44.4**	
300	55.871875	185.871875	90	**45.4**	

310	55.934375	185.934375	90	**45.4**	
320	55.996875	185.996875	89	**44.4**	
330	56.059375	186.059375	91	**46.4**	
340	56.121875	186.121875	89	**44.4**	
350	56.184375	186.184375	90	**45.4**	
360	56.246875	186.246875	91	**46.4**	
370	56.309375	186.309375	92	**47.4**	
380	56.371875	186.371875	89	**44.4**	
390	56.434375	186.434375	92	**47.4**	
395	56.465625	186.465625	90	**45.4**	
400	56.496875	186.496875	95	**50.4**	
402	56.509375	186.509375	96	**51.4**	
405	56.528125	186.528125	90	**45.4**	
410	56.559375	186.559375	92	**47.4**	
415	56.590625	186.590625	94	**49.4**	
418	56.609375	186.609375	88	**43.4**	
420	56.621875	186.621875	88	**43.4**	
425	56.653125	186.653125	92	**47.4**	
430	56.684375	186.684375	90	**45.4**	
435	56.715625	186.715625	93	**48.4**	
440	56.746875	186.746875	95	**50.4**	
450	56.809375	186.809375	95	**50.4**	
455	56.840625	186.840625	94	**49.4**	
458	56.859375	186.859375	90	**45.4**	
460	56.871875	186.871875	90	**45.4**	
470	56.934375	186.934375	91	**46.4**	
475	56.965625	186.965625	92	**47.4**	
480	56.996875	186.996875	95	**50.4**	
490	57.059375	187.059375	93	**48.4**	
495	57.090625	187.090625	93	**48.4**	
497	57.103125	187.103125	90	**45.4**	
500	57.121875	187.121875	87	**42.4**	
510	57.184375	187.184375	88	**43.4**	
520	57.246875	187.246875	88	**43.4**	
525	57.278125	187.278125	87	**42.4**	
530	57.309375	187.309375	91	**46.4**	
535	57.340625	187.340625	89	**44.4**	
540	57.371875	187.371875	85	**40.4**	
560	57.496875	187.496875	83	**38.4**	
580	57.621875	187.621875	82	**37.4**	
600	57.746875	187.746875	82	**37.4**	
620	57.871875	187.871875	81	**36.4**	
640	57.996875	187.996875	81	**36.4**	
660	58.121875	188.121875	81	**36.4**	
680	58.246875	188.246875	83	**38.4**	
690	58.309375	188.309375	85	**40.4**	
700	58.371875	188.371875	85	**40.4**	
703	58.390625	188.390625	91	**46.4**	
705	58.403125	188.403125	94	**49.4**	

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710	58.434375	188.434375	92	**47.4**	
715	58.465625	188.465625	89	**44.4**	
718	58.484375	188.484375	97	**52.4**	
720	58.496875	188.496875	96	**51.4**	
723	58.515625	188.515625	92	**47.4**	
725	58.528125	188.528125	88	**43.4**	
730	58.559375	188.559375	90	**45.4**	
731	58.565625	188.565625	94	**49.4**	
733	58.578125	188.578125	96	**51.4**	
735	58.590625	188.590625	94	**49.4**	
736	58.596875	188.596875	92	**47.4**	
737	58.603125	188.603125	87	**42.4**	
740	58.621875	188.621875	85	**40.4**	
742	58.634375	188.634375	88	**43.4**	
743	58.640625	188.640625	97	**52.4**	
744	58.646875	188.646875	90	**45.4**	
745	58.653125	188.653125	89	**44.4**	
746	58.659375	188.659375	94	**49.4**	
748	58.671875	188.671875	94	**49.4**	
750	58.684375	188.684375	93	**48.4**	
751	58.690625	188.690625	92	**47.4**	
752	58.696875	188.696875	88	**43.4**	
755	58.715625	188.715625	89	**44.4**	
760	58.746875	188.746875	89	**44.4**	
770	58.809375	188.809375	89	**44.4**	
773	58.828125	188.828125	89	**44.4**	Colour
775	58.840625	188.840625	90	**45.4**	
778	58.859375	188.859375	89	**44.4**	
780	58.871875	188.871875	87	**42.4**	
790	58.934375	188.934375	87	**42.4**	
795	58.965625	188.965625	86	**41.4**	
800	58.996875	188.996875	83	**38.4**	
810	59.059375	189.059375	82	**37.4**	
820	59.121875	189.121875	81	**36.4**	
830	59.184375	189.184375	78	**33.4**	
840	59.246875	189.246875	77	**32.4**	
850	59.309375	189.309375	77	**32.4**	
855	59.340625	189.340625	75	**30.4**	
860	59.371875	189.371875	72	**27.4**	
870	59.434375	189.434375	68	**23.4**	
880	59.496875	189.496875	67	**22.4**	
885	59.528125	189.528125	62	**17.4**	
890	59.559375	189.559375	57	**12.4**	
893	59.578125	189.578125	56	**11.4**	Audio and Video
895	59.590625	189.590625	61	**16.4**	Audio only
900	59.621875	189.621875	68	**23.4**	Audio only
910	59.684375	189.684375	69	**24.4**	Audio only
921	59.753125	189.753125	69	**24.4**	Audio / Audio only
930	59.809375	189.809375	66	**21.4**	Audio only

940	59.871875	189.871875	66	**21.4**	Audio only
950	59.934375	189.934375	66	**21.4**	Audio only
955	59.965625	189.965625	64	**19.4**	Audio only
960	59.996875	189.996875	60	**15.4**	Audio only
965	60.028125	190.028125	52	**7.4**	Audio only
970	60.059375	190.059375	44	**-0.6**	Audio only
975	60.090625	190.090625	39	**-5.6**	Audio only
980	60.121875	190.121875	36	**-8.6**	Audio only
990	60.184375	190.184375	35	**-9.6**	Audio only
1000	60.246875	190.246875	32	**-12.6**	Audio only
1010	60.309375	190.309375	32	**-12.6**	Audio and Video
1025	60.403125	190.403125	32	**-12.6**	Audio and Video
1050	60.559375	190.559375	32	**-12.6**	Audio and Video
1060	60.621875	190.621875	32	**-12.6**	Audio and Video
1075	60.715625	190.715625	31	**-13.6**	
1085	60.778125	190.778125	30	**-14.6**	
1100	60.871875	190.871875	30	**-14.6**	
1110	60.934375	190.934375	30	**-14.6**	
1125	61.028125	191.028125	30	**-14.6**	
1135	61.090625	191.090625	29	**-15.6**	
1150	61.184375	191.184375	29	**-15.6**	
1160	61.246875	191.246875	30	**-14.6**	
1175	61.340625	191.340625	29	**-15.6**	
1190	61.434375	191.434375	29	**-15.6**	
1195	61.465625	191.465625	33	**-11.6**	
1200	61.496875	191.496875	34	**-10.6**	
1210	61.559375	191.559375	33	**-11.6**	
1225	61.653125	191.653125	31	**-13.6**	
1235	61.715625	191.715625	31	**-13.6**	
1250	61.809375	191.809375	31	**-13.6**	
1260	61.871875	191.871875	29	**-15.6**	
1275	61.965625	191.965625	29	**-15.6**	
1285	62.028125	192.028125	28	**-16.6**	
1300	62.121875	192.121875	28	**-16.6**	
1310	62.184375	192.184375	27	**-17.6**	
1325	62.278125	192.278125	27	**-17.6**	
1335	62.340625	192.340625	27	**-17.6**	
1350	62.434375	192.434375	27	**-17.6**	
1360	62.496875	192.496875	27	**-17.6**	
1375	62.590625	192.590625	26	**-18.6**	
1385	62.653125	192.653125	26	**-18.6**	
1400	62.746875	192.746875	26	**-18.6**	
1410	62.809375	192.809375	26	**-18.6**	
1425	62.903125	192.903125	26	**-18.6**	
1435	62.965625	192.965625	27	**-17.6**	
1450	63.059375	193.059375	27	**-17.6**	
1460	63.121875	193.121875	27	**-17.6**	

Table A5.3 Interference from one Narrowband PS Signal (25kHz) into DTV

CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
-120	50.987500	180.987500	28	**-29.7**
-100	51.487500	181.487500	30.5	**-27.2**
-80	51.987500	181.987500	32.5	**-25.2**
-50	52.737500	182.737500	33	**-24.7**
-30	53.237500	183.237500	31	**-26.7**
-10	53.737500	183.737500	33.5	**-24.2**
-8	53.787500	183.787500	35.5	**-22.2**
-5	53.862500	183.862500	40	**-17.7**
-2	53.937500	183.937500	44	**-13.7**
1	54.012500	184.012500	48.5	**-9.2**
5	54.112500	184.112500	55	**-2.7**
10	54.237500	184.237500	64.5	**6.8**
11	54.262500	184.262500	68	**10.3**
12	54.287500	184.287500	70.5	**12.8**
13	54.312500	184.312500	75.5	**17.8**
14	54.337500	184.337500	70.5	**12.8**
15	54.362500	184.362500	70	**12.3**
16	54.387500	184.387500	68	**10.3**
20	54.487500	184.487500	66.5	**8.8**
25	54.612500	184.612500	67.5	**9.8**
30	54.737500	184.737500	70.5	**12.8**
40	54.987500	184.987500	71	**13.3**
45	55.112500	185.112500	71.5	**13.8**
46	55.137500	185.137500	73	**15.3**
47	55.162500	185.162500	73	**15.3**
48	55.187500	185.187500	74	**16.3**
49	55.212500	185.212500	74	**16.3**
50	55.237500	185.237500	60	**2.3**
51	55.262500	185.262500	61	**3.3**
52	55.287500	185.287500	60	**2.3**
53	55.312500	185.312500	60.5	**2.8**
54	55.337500	185.337500	61	**3.3**
55	55.362500	185.362500	71.5	**13.8**
60	55.487500	185.487500	72	**14.3**
70	55.737500	185.737500	72	**14.3**
80	55.987500	185.987500	72.5	**14.8**
90	56.237500	186.237500	72.5	**14.8**
100	56.487500	186.487500	72.5	**14.8**
110	56.737500	186.737500	71.5	**13.8**
115	56.862500	186.862500	72	**14.3**
119	56.962500	186.962500	73	**15.3**
120	56.987500	186.987500	75	**17.3**
121	57.012500	187.012500	75	**17.3**
122	57.037500	187.037500	73	**15.3**
125	57.112500	187.112500	73	**15.3**

127	57.162500	187.162500	72.5	**14.8**
130	57.237500	187.237500	72	**14.3**
140	57.487500	187.487500	72.5	**14.8**
150	57.737500	187.737500	72	**14.3**
160	57.987500	187.987500	72	**14.3**
170	58.237500	188.237500	71.5	**13.8**
173	58.312500	188.312500	72.5	**14.8**
175	58.362500	188.362500	73.5	**15.8**
180	58.487500	188.487500	73	**15.3**
185	58.612500	188.612500	72.5	**14.8**
190	58.737500	188.737500	71	**13.3**
200	58.987500	188.987500	71.5	**13.8**
210	59.237500	189.237500	72.5	**14.8**
212	59.287500	189.287500	71	**13.3**
213	59.312500	189.312500	70	**12.3**
215	59.362500	189.362500	70	**12.3**
217	59.412500	189.412500	69.5	**11.8**
219	59.462500	189.462500	69	**11.3**
220	59.487500	189.487500	67	**9.3**
221	59.512500	189.512500	67.5	**9.8**
223	59.562500	189.562500	68	**10.3**
225	59.612500	189.612500	68.5	**10.8**
226	59.637500	189.637500	72	**14.3**
227	59.662500	189.662500	70.5	**12.8**
228	59.687500	189.687500	71	**13.3**
229	59.712500	189.712500	66.5	**8.8**
230	59.737500	189.737500	62.5	**4.8**
240	59.987500	189.987500	56	**-1.7**
250	60.237500	190.237500	49.5	**-8.2**
260	60.487500	190.487500	41	**-16.7**
265	60.612500	190.612500	35	**-22.7**
269	60.712500	190.712500	31	**-26.7**
270	60.737500	190.737500	30.5	**-27.2**
271	60.762500	190.762500	32	**-25.7**
275	60.862500	190.862500	36	**-21.7**
280	60.987500	190.987500	37	**-20.7**
300	61.487500	191.487500	38	**-19.7**
330	62.237500	192.237500	37.5	**-20.2**
350	62.737500	192.737500	37	**-20.7**
361	63.012500	193.012500	36.5	**-21.2**

Table A5.4 Interference from one Narrowband PS Signal (25kHz) into NTSC

CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ ITUR-3 (dB)	D/U @ ITUR-3 (dB)	Note
-120	50.987500	180.987500	30	**-14.4**	
-115	51.112500	181.112500	39	**-5.4**	
-110	51.237500	181.237500	39	**-5.4**	
-105	51.362500	181.362500	42	**-2.4**	
-102	51.437500	181.437500	39	**-5.4**	
-101	51.462500	181.462500	49	**4.6**	
-100	51.487500	181.487500	50	**5.6**	
-99	51.512500	181.512500	42	**-2.4**	
-95	51.612500	181.612500	42	**-2.4**	
-90	51.737500	181.737500	44	**-0.4**	
-85	51.862500	181.862500	39	**-5.4**	
-82	51.937500	181.937500	42	**-2.4**	
-81	51.962500	181.962500	48	**3.6**	
-80	51.987500	181.987500	52	**7.6**	
-79	52.012500	182.012500	49	**4.6**	
-78	52.037500	182.037500	41	**-3.4**	
-75	52.112500	182.112500	39	**-5.4**	
-70	52.237500	182.237500	39	**-5.4**	
-65	52.362500	182.362500	36	**-8.4**	
-60	52.487500	182.487500	39	**-5.4**	
-55	52.612500	182.612500	41	**-3.4**	
-52	52.687500	182.687500	41	**-3.4**	
-50	52.737500	182.737500	45	**0.6**	
-49	52.762500	182.762500	44	**-0.4**	
-48	52.787500	182.787500	40	**-4.4**	
-45	52.862500	182.862500	39	**-5.4**	
-40	52.987500	182.987500	37	**-7.4**	
-35	53.112500	183.112500	36	**-8.4**	
-30	53.237500	183.237500	34	**-10.4**	
-27	53.312500	183.312500	34	**-10.4**	
-26	53.337500	183.337500	39	**-5.4**	
-25	53.362500	183.362500	40	**-4.4**	
-20	53.487500	183.487500	39	**-5.4**	
-15	53.612500	183.612500	42	**-2.4**	
-12	53.687500	183.687500	39	**-5.4**	
-11	53.712500	183.712500	36	**-8.4**	
-10	53.737500	183.737500	31	**-13.4**	
-5	53.862500	183.862500	37	**-7.4**	
-1	53.962500	183.962500	40	**-4.4**	
1	54.012500	184.012500	54	**9.6**	
3	54.062500	184.062500	56	**11.6**	
5	54.112500	184.112500	60	**15.6**	
6	54.137500	184.137500	61	**16.6**	
7	54.162500	184.162500	57	**12.6**	
8	54.187500	184.187500	69	**24.6**	

9	54.212500	184.212500	69	**24.6**	
10	54.237500	184.237500	64	**19.6**	
11	54.262500	184.262500	67	**22.6**	
12	54.287500	184.287500	72	**27.6**	
13	54.312500	184.312500	71	**26.6**	
15	54.362500	184.362500	73	**28.6**	
18	54.437500	184.437500	75	**30.6**	
20	54.487500	184.487500	78	**33.6**	
23	54.562500	184.562500	79	**34.6**	
25	54.612500	184.612500	83	**38.6**	
28	54.687500	184.687500	81	**36.6**	
30	54.737500	184.737500	84	**39.6**	
35	54.862500	184.862500	87	**42.6**	
37	54.912500	184.912500	87	**42.6**	
38	54.937500	184.937500	83	**38.6**	
39	54.962500	184.962500	92	**47.6**	
40	54.987500	184.987500	89	**44.6**	
43	55.062500	185.062500	91	**46.6**	
45	55.112500	185.112500	87	**42.6**	
46	55.137500	185.137500	93	**48.6**	
47	55.162500	185.162500	91	**46.6**	
48	55.187500	185.187500	85	**40.6**	
49	55.212500	185.212500	92	**47.6**	
50	55.237500	185.237500	97	**52.6**	video carrier
51	55.262500	185.262500	90	**45.6**	
52	55.287500	185.287500	93	**48.6**	
53	55.312500	185.312500	95	**50.6**	
54	55.337500	185.337500	96	**51.6**	
55	55.362500	185.362500	85	**40.6**	
56	55.387500	185.387500	95	**50.6**	
57	55.412500	185.412500	95	**50.6**	
58	55.437500	185.437500	86	**41.6**	
59	55.462500	185.462500	94	**49.6**	
60	55.487500	185.487500	96	**51.6**	
62	55.537500	185.537500	90	**45.6**	
64	55.587500	185.587500	95	**50.6**	
65	55.612500	185.612500	86	**41.6**	
66	55.637500	185.637500	94	**49.6**	
68	55.687500	185.687500	89	**44.6**	
69	55.712500	185.712500	93	**48.6**	
70	55.737500	185.737500	98	**53.6**	
73	55.812500	185.812500	94	**49.6**	
74	55.837500	185.837500	94	**49.6**	
75	55.862500	185.862500	88	**43.6**	
76	55.887500	185.887500	93	**48.6**	
78	55.937500	185.937500	92	**47.6**	
79	55.962500	185.962500	89	**44.6**	
80	55.987500	185.987500	96	**51.6**	
83	56.062500	186.062500	92	**47.6**	

84	56.087500	186.087500	95	**50.6**	
85	56.112500	186.112500	88	**43.6**	
86	56.137500	186.137500	90	**45.6**	
88	56.187500	186.187500	94	**49.6**	
90	56.237500	186.237500	92	**47.6**	
93	56.312500	186.312500	92	**47.6**	
95	56.362500	186.362500	93	**48.6**	
98	56.437500	186.437500	93	**48.6**	
100	56.487500	186.487500	91	**46.6**	
103	56.562500	186.562500	92	**47.6**	
105	56.612500	186.612500	94	**49.6**	
108	56.687500	186.687500	93	**48.6**	
110	56.737500	186.737500	91	**46.6**	
113	56.812500	186.812500	88	**43.6**	
115	56.862500	186.862500	92	**47.6**	
118	56.937500	186.937500	93	**48.6**	
120	56.987500	186.987500	89	**44.6**	
123	57.062500	187.062500	86	**41.6**	
125	57.112500	187.112500	91	**46.6**	
128	57.187500	187.187500	91	**46.6**	
130	57.237500	187.237500	86	**41.6**	
133	57.312500	187.312500	87	**42.6**	
135	57.362500	187.362500	89	**44.6**	
138	57.437500	187.437500	90	**45.6**	
140	57.487500	187.487500	85	**40.6**	
143	57.562500	187.562500	85	**40.6**	
145	57.612500	187.612500	88	**43.6**	
148	57.687500	187.687500	86	**41.6**	
150	57.737500	187.737500	83	**38.6**	
153	57.812500	187.812500	84	**39.6**	
155	57.862500	187.862500	89	**44.6**	
158	57.937500	187.937500	86	**41.6**	
160	57.987500	187.987500	86	**41.6**	
163	58.062500	188.062500	87	**42.6**	
165	58.112500	188.112500	89	**44.6**	
168	58.187500	188.187500	88	**43.6**	
170	58.237500	188.237500	86	**41.6**	
173	58.312500	188.312500	90	**45.6**	
175	58.362500	188.362500	91	**46.6**	
178	58.437500	188.437500	89	**44.6**	
180	58.487500	188.487500	89	**44.6**	
183	58.562500	188.562500	94	**49.6**	
185	58.612500	188.612500	91	**46.6**	
188	58.687500	188.687500	87	**42.6**	
189	58.712500	188.712500	93	**48.6**	
190	58.737500	188.737500	94	**49.6**	
191	58.762500	188.762500	86	**41.6**	
192	58.787500	188.787500	94	**49.6**	
193	58.812500	188.812500	96	**51.6**	

194	58.837500	188.837500	93	**48.6**	color subcarrier
195	58.862500	188.862500	88	**43.6**	
199	58.962500	188.962500	93	**48.6**	
200	58.987500	188.987500	93	**48.6**	
203	59.062500	189.062500	91	**46.6**	
204	59.087500	189.087500	89	**44.6**	
205	59.112500	189.112500	81	**36.6**	
208	59.187500	189.187500	82	**37.6**	
209	59.212500	189.212500	86	**41.6**	
210	59.237500	189.237500	89	**44.6**	
213	59.312500	189.312500	87	**42.6**	
214	59.337500	189.337500	82	**37.6**	
215	59.362500	189.362500	74	**29.6**	
218	59.437500	189.437500	76	**31.6**	
220	59.487500	189.487500	75	**30.6**	
223	59.562500	189.562500	68	**23.6**	
224	59.587500	189.587500	64	**19.6**	
225	59.612500	189.612500	66	**21.6**	audio only
229	59.712500	189.712500	69	**24.6**	audio only
230	59.737500	189.737500	73	**28.6**	audio only
231	59.762500	189.762500	73	**28.6**	audio carrier
232	59.787500	189.787500	72	**27.6**	audio only
233	59.812500	189.812500	66	**21.6**	audio only
235	59.862500	189.862500	66	**21.6**	audio only
240	59.987500	189.987500	61	**16.6**	audio only
241	60.012500	190.012500	56	**11.6**	audio only
242	60.037500	190.037500	51	**6.6**	audio only
243	60.062500	190.062500	45	**0.6**	audio only
245	60.112500	190.112500	41	**-3.4**	audio only
250	60.237500	190.237500	35	**-9.4**	audio only
255	60.362500	190.362500	31	**-13.4**	video & audio
260	60.487500	190.487500	32	**-12.4**	
265	60.612500	190.612500	31	**-13.4**	
270	60.737500	190.737500	31	**-13.4**	
275	60.862500	190.862500	30	**-14.4**	
280	60.987500	190.987500	30	**-14.4**	
285	61.112500	191.112500	30	**-14.4**	
290	61.237500	191.237500	30	**-14.4**	
295	61.362500	191.362500	30	**-14.4**	
300	61.487500	191.487500	31	**-13.4**	
305	61.612500	191.612500	30	**-14.4**	
310	61.737500	191.737500	31	**-13.4**	
315	61.862500	191.862500	30	**-14.4**	
320	61.987500	191.987500	30	**-14.4**	
325	62.112500	192.112500	29	**-15.4**	
330	62.237500	192.237500	29	**-15.4**	
335	62.362500	192.362500	29	**-15.4**	
340	62.487500	192.487500	29	**-15.4**	
345	62.612500	192.612500	29	**-15.4**	

350	62.737500	192.737500	29	**-15.4**	
355	62.862500	192.862500	28	**-16.4**	
361	63.012500	193.012500	28	**-16.4**	

Table A5.5 Interference from one Narrowband PS Signal (50kHz) into DTV

CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
-60	50.975000	180.975000	27	**-30.4**
-50	51.475000	181.475000	29.5	**-27.9**
-40	51.975000	181.975000	31	**-26.4**
-30	52.475000	182.475000	32	**-25.4**
-20	52.975000	182.975000	31.5	**-25.9**
-15	53.225000	183.225000	29.5	**-27.9**
-10	53.475000	183.475000	31.5	**-25.9**
-5	53.725000	183.725000	32	**-25.4**
-3	53.825000	183.825000	35	**-22.4**
-1	53.925000	183.925000	40.5	**-16.9**
1	54.025000	184.025000	48	**-9.4**
3	54.125000	184.125000	55	**-2.4**
5	54.225000	184.225000	62	**4.6**
6	54.275000	184.275000	68.5	**11.1**
7	54.325000	184.325000	74.5	**17.1**
8	54.375000	184.375000	69	**11.6**
9	54.425000	184.425000	66.5	**9.1**
10	54.475000	184.475000	67.5	**10.1**
13	54.625000	184.625000	68.5	**11.1**
15	54.725000	184.725000	71	**13.6**
20	54.975000	184.975000	71	**13.6**
23	55.125000	185.125000	72	**14.6**
24	55.175000	185.175000	73	**15.6**
25	55.225000	185.225000	58	**0.6**
26	55.275000	185.275000	58	**0.6**
27	55.325000	185.325000	71	**13.6**
28	55.375000	185.375000	71.5	**14.1**
30	55.475000	185.475000	71.5	**14.1**
35	55.725000	185.725000	71	**13.6**
40	55.975000	185.975000	72	**14.6**
45	56.225000	186.225000	71.5	**14.1**
50	56.475000	186.475000	72	**14.6**
55	56.725000	186.725000	72	**14.6**
58	56.875000	186.875000	72	**14.6**
59	56.925000	186.925000	72.5	**15.1**
60	56.975000	186.975000	74	**16.6**
61	57.025000	187.025000	73	**15.6**
62	57.075000	187.075000	72.5	**15.1**
63	57.125000	187.125000	71.5	**14.1**
65	57.225000	187.225000	71.5	**14.1**
68	57.375000	187.375000	72	**14.6**

70	57.475000	187.475000	73	**15.6**
72	57.575000	187.575000	71.5	**14.1**
75	57.725000	187.725000	71.5	**14.1**
80	57.975000	187.975000	71.5	**14.1**
85	58.225000	188.225000	71.5	**14.1**
90	58.475000	188.475000	72	**14.6**
95	58.725000	188.725000	71.5	**14.1**
100	58.975000	188.975000	71	**13.6**
105	59.225000	189.225000	71.5	**14.1**
108	59.375000	189.375000	70	**12.6**
110	59.475000	189.475000	68.5	**11.1**
113	59.625000	189.625000	69	**11.6**
114	59.675000	189.675000	68	**10.6**
115	59.725000	189.725000	62.5	**5.1**
118	59.875000	189.875000	60	**2.6**
120	59.975000	189.975000	55	**-2.4**
125	60.225000	190.225000	46.5	**-10.9**
130	60.475000	190.475000	39	**-18.4**
133	60.625000	190.625000	32	**-25.4**
135	60.725000	190.725000	29.5	**-27.9**
138	60.875000	190.875000	35	**-22.4**
140	60.975000	190.975000	36	**-21.4**
150	61.475000	191.475000	36.5	**-20.9**
160	61.975000	191.975000	36	**-21.4**
170	62.475000	192.475000	36	**-21.4**
180	62.975000	192.975000	35.5	**-21.9**

Table A5.6 Interference from one Narrowband PS Signal (50kHz) into NTSC

No result.

Table A5.7 Interference from one Narrowband PS Signal (150kHz) into DTV

CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
-20	50.925000	180.925000	25.5	**-31.9**
-19	51.075000	181.075000	26.5	**-30.9**
-18	51.225000	181.225000	27	**-30.4**
-17	51.375000	181.375000	27.5	**-29.9**
-16	51.525000	181.525000	28.5	**-28.9**
-15	51.675000	181.675000	29	**-28.4**
-14	51.825000	181.825000	29.5	**-27.9**
-13	51.975000	181.975000	30	**-27.4**
-12	52.125000	182.125000	30.5	**-26.9**
-11	52.275000	182.275000	30.5	**-26.9**
-10	52.425000	182.425000	31	**-26.4**
-9	52.575000	182.575000	31	**-26.4**
-8	52.725000	182.725000	30.5	**-26.9**
-7	52.875000	182.875000	30	**-27.4**
-6	53.025000	183.025000	29.5	**-27.9**
-5	53.175000	183.175000	29	**-28.4**
-4	53.325000	183.325000	30	**-27.4**
-3	53.475000	183.475000	31.5	**-25.9**
-2	53.625000	183.625000	32.5	**-24.9**
-1	53.775000	183.775000	30	**-27.4**
1	54.075000	184.075000	53	**-4.4**
2	54.225000	184.225000	64	**6.6**
3	54.375000	184.375000	69.5	**12.1**
4	54.525000	184.525000	70	**12.6**
5	54.675000	184.675000	71.5	**14.1**
6	54.825000	184.825000	71	**13.6**
7	54.975000	184.975000	72	**14.6**
8	55.125000	185.125000	73.5	**16.1**
9	55.275000	185.275000	57	**-0.4**
10	55.425000	185.425000	72.5	**15.1**
11	55.575000	185.575000	72.5	**15.1**
12	55.725000	185.725000	72.5	**15.1**
13	55.875000	185.875000	73	**15.6**
14	56.025000	186.025000	73	**15.6**
15	56.175000	186.175000	72.5	**15.1**
16	56.325000	186.325000	72.5	**15.1**
17	56.475000	186.475000	73	**15.6**
18	56.625000	186.625000	72.5	**15.1**
19	56.775000	186.775000	72.5	**15.1**
20	56.925000	186.925000	73	**15.6**
21	57.075000	187.075000	73	**15.6**
22	57.225000	187.225000	72.5	**15.1**
23	57.375000	187.375000	72.5	**15.1**
24	57.525000	187.525000	72.5	**15.1**
25	57.675000	187.675000	72.5	**15.1**

26	57.825000	187.825000	73	**15.6**
27	57.975000	187.975000	73	**15.6**
28	58.125000	188.125000	72.5	**15.1**
29	58.275000	188.275000	72.5	**15.1**
30	58.425000	188.425000	73	**15.6**
31	58.575000	188.575000	73	**15.6**
32	58.725000	188.725000	72.5	**15.1**
33	58.875000	188.875000	73	**15.6**
34	59.025000	189.025000	72.5	**15.1**
35	59.175000	189.175000	72	**14.6**
36	59.325000	189.325000	71.5	**14.1**
37	59.475000	189.475000	70.5	**13.1**
38	59.625000	189.625000	69	**11.6**
39	59.775000	189.775000	66	**8.6**
40	59.925000	189.925000	57	**-0.4**
41	60.075000	190.075000	47.5	**-9.9**
42	60.225000	190.225000	43.5	**-13.9**
43	60.375000	190.375000	39	**-18.4**
44	60.525000	190.525000	34	**-23.4**
45	60.675000	190.675000	28	**-29.4**
46	60.825000	190.825000	32	**-25.4**
47	60.975000	190.975000	34.5	**-22.9**
48	61.125000	191.125000	35	**-22.4**
49	61.275000	191.275000	35	**-22.4**
50	61.425000	191.425000	35	**-22.4**
51	61.575000	191.575000	35	**-22.4**
52	61.725000	191.725000	35.5	**-21.9**
53	61.875000	191.875000	35	**-22.4**
54	62.025000	192.025000	35	**-22.4**
55	62.175000	192.175000	35	**-22.4**
56	62.325000	192.325000	35	**-22.4**
57	62.475000	192.475000	35	**-22.4**
58	62.625000	192.625000	35	**-22.4**
59	62.775000	192.775000	34.5	**-22.9**
60	62.925000	192.925000	34.5	**-22.9**
61	63.075000	193.075000	34.5	**-22.9**

Table A5.8 Interference from one Narrowband PS Signal (150kHz) into NTSC

CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ ITUR-3 (dB)	D/U @ ITUR-3 (dB)	Note
-20	50.925000	180.925000	27	**-17.1**	
-19	51.075000	181.075000	35	**-9.1**	
-18	51.225000	181.225000	35	**-9.1**	
-17	51.375000	181.375000	41	**-3.1**	
-16	51.525000	181.525000	43	**-1.1**	
-15	51.675000	181.675000	46	**1.9**	
-14	51.825000	181.825000	41	**-3.1**	
-13	51.975000	181.975000	43	**-1.1**	
-12	52.125000	182.125000	38	**-6.1**	
-11	52.275000	182.275000	35	**-9.1**	
-10	52.425000	182.425000	35	**-9.1**	
-9	52.575000	182.575000	39	**-5.1**	
-8	52.725000	182.725000	38	**-6.1**	
-7	52.875000	182.875000	38	**-6.1**	
-6	53.025000	183.025000	35	**-9.1**	
-5	53.175000	183.175000	35	**-9.1**	
-4	53.325000	183.325000	35	**-9.1**	
-3	53.475000	183.475000	39	**-5.1**	
-2	53.625000	183.625000	36	**-8.1**	
-1	53.775000	183.775000	31	**-13.1**	
0	53.925000	183.925000	37	**-7.1**	
1	54.075000	184.075000	56	**11.9**	
2	54.225000	184.225000	64	**19.9**	
3	54.375000	184.375000	69	**24.9**	
4	54.525000	184.525000	73	**28.9**	
5	54.675000	184.675000	80	**35.9**	
6	54.825000	184.825000	82	**37.9**	
7	54.975000	184.975000	84	**39.9**	
8	55.125000	185.125000	90	**45.9**	
9	55.275000	185.275000	92	**47.9**	video carrier
10	55.425000	185.425000	92	**47.9**	
11	55.575000	185.575000	90	**45.9**	
12	55.725000	185.725000	91	**46.9**	
13	55.875000	185.875000	91	**46.9**	
14	56.025000	186.025000	92	**47.9**	
15	56.175000	186.175000	90	**45.9**	
16	56.325000	186.325000	89	**44.9**	
17	56.475000	186.475000	88	**43.9**	
18	56.625000	186.625000	88	**43.9**	
19	56.775000	186.775000	87	**42.9**	
20	56.925000	186.925000	86	**41.9**	
21	57.075000	187.075000	85	**40.9**	
22	57.225000	187.225000	85	**40.9**	
23	57.375000	187.375000	84	**39.9**	
24	57.525000	187.525000	84	**39.9**	

25	57.675000	187.675000	83	**38.9**	
26	57.825000	187.825000	82	**37.9**	
27	57.975000	187.975000	82	**37.9**	
28	58.125000	188.125000	83	**38.9**	
29	58.275000	188.275000	85	**40.9**	
30	58.425000	188.425000	88	**43.9**	
31	58.575000	188.575000	89	**44.9**	
32	58.725000	188.725000	92	**47.9**	
33	58.875000	188.875000	89	**44.9**	color subcarrier
34	59.025000	189.025000	88	**43.9**	
35	59.175000	189.175000	84	**39.9**	
36	59.325000	189.325000	77	**32.9**	
37	59.475000	189.475000	68	**23.9**	
38	59.625000	189.625000	64	**19.9**	audio only
39	59.775000	189.775000	65	**20.9**	audio carrier
40	59.925000	189.925000	64	**19.9**	audio only
41	60.075000	190.075000	43	**-1.1**	audio only
42	60.225000	190.225000	34	**-10.1**	audio only
43	60.375000	190.375000	31	**-13.1**	video and audio
44	60.525000	190.525000	31	**-13.1**	video and audio
45	60.675000	190.675000	31	**-13.1**	
46	60.825000	190.825000	29	**-15.1**	
47	60.975000	190.975000	30	**-14.1**	
48	61.125000	191.125000	29	**-15.1**	
49	61.275000	191.275000	29	**-15.1**	
50	61.425000	191.425000	29	**-15.1**	
51	61.575000	191.575000	30	**-14.1**	
52	61.725000	191.725000	30	**-14.1**	
53	61.875000	191.875000	29	**-15.1**	
54	62.025000	192.025000	29	**-15.1**	
55	62.175000	192.175000	29	**-15.1**	
56	62.325000	192.325000	29	**-15.1**	
57	62.475000	192.475000	29	**-15.1**	
58	62.625000	192.625000	28	**-16.1**	
59	62.775000	192.775000	28	**-16.1**	
60	62.925000	192.925000	28	**-16.1**	
61	63.075000	193.075000	28	**-16.1**	

Table A5.9 Result for Scenario A PS Transmission into DTV

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
13	57	187	72.5	**14.7**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
20	51.15	181.15	31.5	**-26.3**
19	51	181	31.5	**-26.3**
18	50.85	180.85	30	**-27.8**
17	50.7	180.7	27.5	**-30.3**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	62.925	192.925	32	**-25.8**
2	62.93125	192.93125	31.5	**-26.3**
3	62.9375	192.9375	31.5	**-26.3**
4	62.94375	192.94375	31.5	**-26.3**
5	62.95	192.95	31	**-26.8**
6	62.95625	192.95625	31	**-26.8**
7	62.9625	192.9625	31	**-26.8**
8	62.96875	192.96875	30.5	**-27.3**
9	62.975	192.975	30.5	**-27.3**
10	62.98125	192.98125	30	**-27.8**
11	62.9875	192.9875	30	**-27.8**
12	62.99375	192.99375	30	**-27.8**
13	63	193	30	**-27.8**
23	63.0625	193.0625	29	**-28.8**
33	63.125	193.125	27.5	**-30.3**
43	63.1875	193.1875	26.5	**-31.3**
53	63.25	193.25	26	**-31.8**
93	63.5	193.5	26.5	**-31.3**

Table A5.10 Result for Scenario A PS Transmission into NTSC

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
13	57	187	81	**36.5**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
20	51.15	181.15	40	**-4.5**
19	51	181	39	**-5.5**
18	50.85	180.85	38	**-6.5**
17	50.7	180.7	37	**-7.5**
16	50.55	180.55	37	**-7.5**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	62.925	192.925	33	**-11.5**
2	62.93125	192.93125	32	**-12.5**
3	62.9375	192.9375	31	**-13.5**
4	62.94375	192.94375	29	**-15.5**

5	62.95	192.95	29	**-15.5**
6	62.95625	192.95625	29	**-15.5**
7	62.9625	192.9625	29	**-15.5**
8	62.96875	192.96875	29	**-15.5**
9	62.975	192.975	28	**-16.5**
10	62.98125	192.98125	28	**-16.5**
11	62.9875	192.9875	28	**-16.5**
12	62.99375	192.99375	27	**-17.5**
13	63	193	27	**-17.5**
23	63.0625	193.0625	26	**-18.5**
33	63.125	193.125	26	**-18.5**
43	63.1875	193.1875	25	**-19.5**
53	63.25	193.25	25	**-19.5**
93	63.5	193.5	24	**-20.5**

Table A5.11 Result for Scenario B PS Transmission into DTV

Co-Channel CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
4	57	187	73.3	**15.6**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
20	51.15	181.15	33	**-24.7**
19	51	181	33	**-24.7**
18	50.85	180.85	31	**-26.7**
17	50.7	180.7	30	**-27.7**
15	50.4	180.4	29.5	**-28.2**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	62.925	192.925	33.5	**-24.2**
2	62.95	192.95	32.5	**-25.2**
3	62.975	192.975	31.5	**-26.2**
4	63	193	31	**-26.7**
5	63.025	193.025	31	**-26.7**
6	63.05	193.05	30	**-27.7**
7	63.075	193.075	29.5	**-28.2**
8	63.1	193.1	29	**-28.7**
12	63.2	193.2	27	**-30.7**
16	63.3	193.3	25	**-32.7**
20	63.4	193.4	25	**-32.7**
24	63.5	193.5	27	**-30.7**
28	63.6	193.6	27.5	**-30.2**
32	63.7	193.7	27.5	**-30.2**

Table A5.12 Result for Scenario B PS Transmission into NTSC

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
4	57	187	82	**37.4**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
20	51.15	181.15	42	**-2.6**
19	51	181	41	**-3.6**
18	50.85	180.85	40	**-4.6**
17	50.7	180.7	39	**-5.6**
15	50.4	180.4	37	**-7.6**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	62.925	192.925	33	**-11.6**
2	62.95	192.95	31	**-13.6**
3	62.975	192.975	29	**-15.6**
4	63	193	29	**-15.6**
5	63.025	193.025	29	**-15.6**
6	63.05	193.05	29	**-15.6**
7	63.075	193.075	29	**-15.6**
8	63.1	193.1	29	**-15.6**
9	63.125	193.125	29	**-15.6**
12	63.2	193.2	28	**-16.6**
16	63.3	193.3	28	**-16.6**
20	63.4	193.4	27	**-17.6**
24	63.5	193.5	27	**-17.6**
28	63.6	193.6	27	**-17.6**
32	63.7	193.7	26	**-18.6**

Table A5.13 Result for Scenario C PS Transmission into DTV

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
1	57	187	71.6	**14.4**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
480	51.24375	181.24375	31.5	**-25.7**
478	51.23125	181.23125	31	**-26.2**
475	51.2125	181.2125	30	**-27.2**
470	51.18125	181.18125	28.5	**-28.7**
465	51.15	181.15	28	**-29.2**
460	51.11875	181.11875	27	**-30.2**
450	51.05625	181.05625	24.5	**-32.7**
441	51	181	23.5	**-33.7**
421	50.875	180.875	22	**-35.2**
401	50.75	180.75	21	**-36.2**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	63	193	34.5	**-22.7**
2	63.15	193.15	32	**-25.2**

3	63.3	193.3	27.5	**-29.7**
4	63.45	193.45	25	**-32.2**
5	63.6	193.6	26.5	**-30.7**
6	63.75	193.75	28	**-29.2**
7	63.9	193.9	28.5	**-28.7**

Table A5.14 Result for Scenario C PS Transmission into NTSC

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
1	57	187	84	**39.6**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
480	51.24375	181.24375	34	**-10.4**
478	51.23125	181.23125	34	**-10.4**
475	51.2125	181.2125	34	**-10.4**
470	51.18125	181.18125	34	**-10.4**
465	51.15	181.15	33	**-11.4**
460	51.11875	181.11875	32	**-12.4**
450	51.05625	181.05625	32	**-12.4**
441	51	181	32	**-12.4**
421	50.875	180.875	32	**-12.4**
401	50.75	180.75	33	**-11.4**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	63	193	37	**-7.4**
2	63.15	193.15	34	**-10.4**
3	63.3	193.3	33	**-11.4**
4	63.45	193.45	32	**-12.4**
5	63.6	193.6	32	**-12.4**
6	63.75	193.75	31	**-13.4**
7	63.9	193.9	30	**-14.4**

Table A5.15 Result for Scenario D PS Transmission into DTV

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
1	57	187	72.7	**15.8**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
120	51.225	181.225	32	**-24.9**
119	51.2	181.2	31	**-25.9**
118	51.175	181.175	29.5	**-27.4**
115	51.1	181.1	27.5	**-29.4**
113	51.05	181.05	27.5	**-29.4**
111	51	181	27	**-29.9**
101	50.75	180.75	24.5	**-32.4**
91	50.5	180.5	24.5	**-32.4**

Upper CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
1	63	193	35	**-21.9**
2	63.15	193.15	32.5	**-24.4**
3	63.3	193.3	29	**-27.9**
4	63.45	193.45	27	**-29.9**
5	63.6	193.6	28	**-28.9**
6	63.75	193.75	29	**-27.9**
7	63.9	193.9	29	**-27.9**

Table A5.16 Result for Scenario D PS Transmission into NTSC

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
1	57	187	83	**38.8**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
120	51.225	181.225	36	**-8.2**
119	51.2	181.2	36	**-8.2**
118	51.175	181.175	36	**-8.2**
115	51.1	181.1	36	**-8.2**
113	51.05	181.05	36	**-8.2**
111	51	181	35	**-9.2**
101	50.75	180.75	35	**-9.2**
91	50.5	180.5	34	**-10.2**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	63	193	38	**-6.2**
2	63.15	193.15	35	**-9.2**
3	63.3	193.3	35	**-9.2**
4	63.45	193.45	34	**-10.2**
5	63.6	193.6	33	**-11.2**
6	63.75	193.75	32	**-12.2**
7	63.9	193.9	32	**-12.2**

Table A5.17 Result for Scenario E PS Transmission into DTV

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
13	57	187	73.6	**15.9**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
60	51.2	181.2	35	**-22.7**
59	51.15	181.15	33	**-24.7**
58	51.1	181.1	33	**-24.7**
57	51.05	181.05	33	**-24.7**
56	51	181	33	**-24.7**
55	50.95	180.95	32.5	**-25.2**
54	50.9	180.9	32	**-25.7**
53	50.85	180.85	31.5	**-26.2**

52	50.8	180.8	30.5	**-27.2**
48	50.6	180.6	30	**-27.7**
44	50.4	180.4	29	**-28.7**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	62.925	192.925	35.5	**-22.2**
2	62.93125	192.93125	35.5	**-22.2**
3	62.9375	192.9375	35.5	**-22.2**
4	62.94375	192.94375	35.5	**-22.2**
5	62.95	192.95	35	**-22.7**
7	62.9625	192.9625	35	**-22.7**
9	62.975	192.975	35	**-22.7**
11	62.9875	192.9875	34.5	**-23.2**
13	63	193	34	**-23.7**
23	63.0625	193.0625	33	**-24.7**
33	63.125	193.125	31.5	**-26.2**
43	63.1875	193.1875	30.5	**-27.2**
53	63.25	193.25	29.5	**-28.2**
93	63.5	193.5	28.5	**-29.2**

Table A5.18 Result for Scenario E PS Transmission into NTSC

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
13	57	187	82	**37.2**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
60	51.2	181.2	41	**-3.8**
59	51.15	181.15	41	**-3.8**
58	51.1	181.1	40	**-4.8**
57	51.05	181.05	40	**-4.8**
56	51	181	40	**-4.8**
55	50.95	180.95	40	**-4.8**
54	50.9	180.9	39	**-5.8**
53	50.85	180.85	39	**-5.8**
52	50.8	180.8	39	**-5.8**
48	50.6	180.6	37	**-7.8**
44	50.4	180.4	36	**-8.8**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	62.925	192.925	33	**-11.8**
2	62.93125	192.93125	33	**-11.8**
3	62.9375	192.9375	32	**-12.8**
4	62.94375	192.94375	31	**-13.8**
5	62.95	192.95	31	**-13.8**
6	62.95625	192.95625	31	**-13.8**
7	62.9625	192.9625	31	**-13.8**
8	62.96875	192.96875	30	**-14.8**
9	62.975	192.975	30	**-14.8**
10	62.98125	192.98125	30	**-14.8**

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11	62.9875	192.9875	30	**-14.8**
13	63	193	30	**-14.8**
23	63.0625	193.0625	30	**-14.8**
33	63.125	193.125	29	**-15.8**
43	63.1875	193.1875	28	**-16.8**
53	63.25	193.25	27	**-17.8**
93	63.5	193.5	26	**-18.8**

Table A5.19 Result for Scenario F PS Transmission into DTV

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
4	57	187	73.6	**15.6**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
60	51.2	181.2	35	**-23**
59	51.15	181.15	33.5	**-24.5**
58	51.1	181.1	33	**-25**
57	51.05	181.05	32.5	**-25.5**
56	51	181	32	**-26**
55	50.95	180.95	32	**-26**
54	50.9	180.9	31.5	**-26.5**
53	50.85	180.85	31	**-27**
52	50.8	180.8	31	**-27**
48	50.6	180.6	31	**-27**
44	50.4	180.4	30	**-28**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	62.925	192.925	38	**-20**
2	62.95	192.95	37.5	**-20.5**
3	62.975	192.975	36.5	**-21.5**
4	63	193	36	**-22**
5	63.025	193.025	35	**-23**
6	63.05	193.05	35	**-23**
7	63.075	193.075	34.5	**-23.5**
8	63.1	193.1	34.5	**-23.5**
12	63.2	193.2	32	**-26**
16	63.3	193.3	30	**-28**
20	63.4	193.4	28.5	**-29.5**
24	63.5	193.5	29	**-29**
28	63.6	193.6	29.5	**-28.5**
32	63.7	193.7	29.5	**-28.5**

Table A5.20 Result for Scenario F PS Transmission into NTSC

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
4	57	187	82	**37**

Lower CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
60	51.2	181.2	42	**-3**
59	51.15	181.15	41	**-4**
58	51.1	181.1	41	**-4**
57	51.05	181.05	41	**-4**
56	51	181	41	**-4**
55	50.95	180.95	40	**-5**
54	50.9	180.9	40	**-5**
53	50.85	180.85	40	**-5**
52	50.8	180.8	39	**-6**
48	50.6	180.6	39	**-6**
44	50.4	180.4	38	**-7**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	62.925	192.925	37	**-8**
2	62.95	192.95	35	**-10**
3	62.975	192.975	34	**-11**
4	63	193	33	**-12**
5	63.025	193.025	33	**-12**
6	63.05	193.05	33	**-12**
7	63.075	193.075	32	**-13**
8	63.1	193.1	32	**-13**
9	63.125	193.125	32	**-13**
10	63.15	193.15	32	**-13**
12	63.2	193.2	32	**-13**
16	63.3	193.3	32	**-13**
20	63.4	193.4	32	**-13**
24	63.5	193.5	31	**-14**
28	63.6	193.6	31	**-14**

Table A5.21 Result for Scenario G PS Transmission into DTV

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
1	57	187	72	**14.5**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
480	51.24375	181.24375	32.5	**-25**
478	51.23125	181.23125	32	**-25.5**
475	51.2125	181.2125	31	**-26.5**
470	51.18125	181.18125	30	**-27.5**
465	51.15	181.15	29	**-28.5**
460	51.11875	181.11875	27.5	**-30**
450	51.05625	181.05625	27	**-30.5**
441	51	181	26	**-31.5**
421	50.875	180.875	24	**-33.5**
401	50.75	180.75	23.5	**-34**

Upper CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
1	63	193	38.5	**-19**
2	63.05	193.05	36.5	**-21**
3	63.1	193.1	35.5	**-22**
4	63.15	193.15	35	**-22.5**
5	63.2	193.2	34	**-23.5**
6	63.25	193.25	32.5	**-25**
11	63.5	193.5	27	**-30.5**

Table A5.22 Result for Scenario G PS Transmission into NTSC

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
1	57	187	83	**38.5**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
480	51.24375	181.24375	36	**-8.5**
475	51.2125	181.2125	36	**-8.5**
470	51.18125	181.18125	36	**-8.5**
465	51.15	181.15	35	**-9.5**
460	51.11875	181.11875	35	**-9.5**
450	51.05625	181.05625	34	**-10.5**
441	51	181	34	**-10.5**
421	50.875	180.875	34	**-10.5**
401	50.75	180.75	34	**-10.5**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	63	193	41	**-3.5**
2	63.05	193.05	37	**-7.5**
3	63.1	193.1	37	**-7.5**
4	63.15	193.15	36	**-8.5**
5	63.2	193.2	36	**-8.5**
6	63.25	193.25	35	**-9.5**
7	63.3	193.3	34	**-10.5**
11	63.5	193.5	32	**-12.5**

Table A5.23 Result for Scenario H PS Transmission into DTV

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
1	57	187	73	**15.2**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
120	51.225	181.225	34.5	**-23.3**
119	51.2	181.2	33.5	**-24.3**
118	51.175	181.175	32	**-25.8**
115	51.1	181.1	30.5	**-27.3**
113	51.05	181.05	30.5	**-27.3**
111	51	181	29.5	**-28.3**

101	50.75	180.75	28	**-29.8**
91	50.5	180.5	28	**-29.8**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	63	193	36.5	**-21.3**
2	63.05	193.05	34.5	**-23.3**
3	63.1	193.1	34	**-23.8**
4	63.15	193.15	32.5	**-25.3**
5	63.2	193.2	31.5	**-26.3**
6	63.25	193.25	30.5	**-27.3**
11	63.5	193.5	27.5	**-30.3**

Table A5.24 Result for Scenario H PS Transmission into NTSC

Co-Channel CHANNEL NO.	FREQUENCY (MHz)	Local Oscillator #2 (MHz)	PS Att. @ TOV (dB)	D/U @ TOV (dB)
1	57	187	83	**38.4**
Lower CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
120	51.225	181.225	40	**-4.6**
119	51.2	181.2	40	**-4.6**
118	51.175	181.175	39	**-5.6**
115	51.1	181.1	39	**-5.6**
113	51.05	181.05	39	**-5.6**
111	51	181	38	**-6.6**
101	50.75	180.75	38	**-6.6**
91	50.5	180.5	36	**-8.6**
Upper CHANNEL NO.	**FREQUENCY (MHz)**	**Local Oscillator #2 (MHz)**	**PS Att. @ TOV (dB)**	**D/U @ TOV (dB)**
1	63	193	38	**-6.6**
2	63.05	193.05	36	**-8.6**
3	63.1	193.1	36	**-8.6**
4	63.15	193.15	35	**-9.6**
5	63.2	193.2	34	**-10.6**
6	63.25	193.25	34	**-10.6**
7	63.3	193.3	33	**-11.6**
11	63.5	193.5	31	**-13.6**