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November 2017
KXLY-TV Channel 13
Spokane, Washington
Request for Waiver of §73.622(f)(7)

KXLY-TV is a commercial television station which is owned and operated by Spokane Television, Inc. (“Spokane Television”). Licensed to Spokane, Washington, KXLY-TV is the ABC affiliate for a large portion of eastern Washington and northern Idaho. The station first signed on the air in 1953, and since that time has been variously a CBS or ABC affiliate, with ABC affiliation continuously since 1976.

KXLY-TV operated since its inception on analog Channel 4, and in 1999 activated its first digital facility on Channel 13. KXLY-TV operates its digital facility with an ERP of 23.3 kW, from a transmitter site on Mount Spokane.

The instant application requests operation with a power increase to an ERP of 34.5 kW at an HAAT of 936 meters. This ERP value is greater than that which would be permitted by routine application of the table in §73.622(f)(7) of the Commission’s Rules, and also results in a noise limited contour area which is larger than that of the largest station within the market. (KXLY-TV is the largest station in the Spokane television market.)[1]

Since commencing DTV operation on Channel 13, KXLY-TV has – like numerous other VHF digital stations across the country – experienced reception problems which were not apparent during pre-transition digital operations. The licensee has received a number of complaints from viewers,

[1] KXLY-TV had originally requested operation at 46 kW ERP in BMPCDT-20100819ABL. After new analysis with the current version of the Commission’s TVStudy software, using the 1-second terrain database and 2010 Census data, the requested ERP has been reduced to 34.5 kW in order to comply with interference protection requirements to KTVR(TV) at La Grande, Oregon.

former viewers, and would-be viewers about lack of reception and degraded reception. Its engineering staff has verified reception problems in the field, and, as shown below, the problems can be traced to interference of a type that should be remediable with the proposed power increase. In light of the compelling need to improve reception of KXLY-TV, Spokane Television respectfully requests waiver of §73.622(f)(7) of the Commission's Rules to permit operation with an ERP of 34.5 kW.

Interference from FM Stations

In the article "Testing for DTV Interference" published in TV Technology on June 22, 2009 (available online at www.tvtechnology.com/article/82716 and attached hereto), well-known television engineer Charles W. Rhodes described the mechanisms by which high-power FM signals can produce second harmonic and A+B mix products in DTV receivers which fall within high-band VHF channels. The A+B mix products are particularly problematic because they manifest 6 dB stronger than either of the second harmonics.

In the Spokane market where KXLY-TV is located, for example, there are four high-power FM stations which produce either second harmonic or A+B mix products in the receiver which fall within the 210-216 MHz spectrum of Channel 13. Those stations are:

Callsign	**Frequency**	**Community of License**	**ERP**
KCDA	103.1 MHz	Post Falls	18.5 kW
KBBD	103.9 MHz	Spokane	34 kW
KZBD	105.7 MHz	Spokane	100 kW
KMBI-FM	107.9 MHz	Spokane	64 kW

Of these stations, there are two which produce second harmonics within the Channel 13 spectrum, namely KZBD 105.7 MHz (second harmonic 211.4 MHz) and KMBI-FM 107.9 MHz (second harmonic 215.8 MHz).

Mr. Rhodes lives near Portland, Oregon, and as described in the article has performed tests of ten NTIA-approved downconverters at his home 14 miles from the Portland FM towers. Those tests confirmed that the total received power of the FM signals was -26 dBm, *some 10 dB stronger* than any DTV signal at that location.

As noted in Mr. Rhodes' article, interference from FM stations to high-band VHF can be eliminated by utilizing either an FM trap or a 75 ohm high pass filter (which attenuates FM and low-band VHF signals, but passes high-band VHF and UHF signals) at the input to affected DTV receivers. Indeed, KXLY-TV engineers have first-hand field experience with the use of these techniques. In numerous cases, the application of either an FM trap or high pass filter has resulted in a marked improvement in reception of KXLY-TV on affected receivers. The additional filtering has often made the difference between truly robust reception and marginal or no reception of KXLY-TV.

This first-hand experience demonstrates that not only is the FM interference mechanism described above a theoretical possibility, but it is also a real-world fact affecting reception of KXLY-TV. Nevertheless the use of filtering techniques, while a solution in individual cases, is not a universal solution owing to the impracticality of providing every affected receiver with an appropriate filter. Many viewers experiencing reception problems will not know where to turn for help, and many will simply assume that nothing can be done.

Conclusion

While the 1.7 dB power increase requested herein cannot be expected to resolve all reception problems experienced by viewers of KXLY-TV, this increase will help by raising the KXLY-TV received signal strength higher relative to the noise floor to which the FM products (and man-made and sky noise not accounted for in the FCC DTV planning factors) contribute. Furthermore, as is demonstrated in the interference study included in this application, operation of KXLY-TV at the power level requested herein will not result in prohibited interference to any other station (except that which is consented to by the licensee of KUID-TV). It is therefore submitted that operation of KXLY-TV at 34.5 kW ERP would be in the public interest, and waiver of §73.622(f)(7) of the Commission's Rules is warranted and respectfully requested.

Testing for DTV Interference

June 22, 2009

By Charles W. Rhodes

A colleague of mine, Linley Gumm and I have just completed a set of interferenc
NTIA-approved DTV downconverters.

We were concerned that powerful FM radio signals between 88.1 and 107.9 MHz
the rather limited RF selectivity of modern DTV tuners at levels that would overlo
generating second order distortion products that just happen to fall in the 174–21

Band.

Before I reveal our findings, a little background is in order.

Any active device, amplifier or mixer will generate second order distortion products given that the input signal voltage overloads the active device. There are two second order distortion products, one you know well from audio: second harmonic distortion, and the other you know from the fundamentals of superheterodyne receivers mixing. There we have a signal at some frequency Fs and it is mixed with a much stronger Local Oscillator at a frequency Fo.

In radios, Fo was always 455 kHz above Fs so the useful mixing product was Fo – Fs = the IF frequency, nominally 455 kHz. But there are two such mixing products, the other is Fs + Fo, which in the case of radios was filtered out. That example was for a simple AM receiver.

Now fast forward to two FM radio signals at say 90.7 MHz and another at 92.1 MHz, which reach the mixer. The mixer output will contain 181.4 MHz and 184.2 MHz components, which are the second harmonics of these FM signals. Both land in Channel 8 (180 – 186 MHz).

There will also be what I call the Sum frequency: 90.7 MHz + 92.1 MHz = 182.8 MHz, which is also in Channel 8, but this one is 6 dB stronger than either second harmonic. This is shown in Fig. 1 of the spectrum of these second order distortion products of two FM band signals.

In Fig. 1 the scale is 2 dB per major graticule division, so it is clear that the Sum frequency is 6 dB stronger than the second harmonics. In this example all three second order distortion products fall in the same channel.

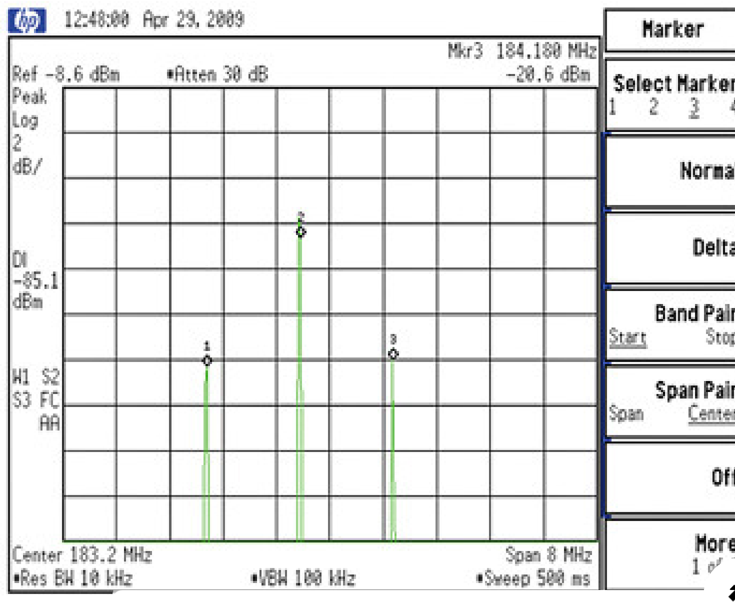

Fig. 1: Secor

Now consider this example: F1 = 88.5 MHz and F2 = 107.3 MHz. The second harmonic of F1 lies within Channel 7, that of F2 lies in Channel 13 while their Sum = 195.8 MHz in Channel 10.

You must be thinking that if this is true, why don't we have interference from FM signals in analog TV receivers?

FM Traps

The answer is that this interference mechanism was well understood when the FCC planned the post-World War II VHF spectrum in 1944. And so did the receiver manufacturers who were able to provide enough RF selectivity before the mixer that this interference mechanism was not too much of a problem.

But because some viewers might live quite near FM transmitters while the TV towers were located elsewhere, sometimes on mountain tops, the better receiver had FM traps, which attenuated FM band signals before they ever reached the tuner. Such FM traps were described in K. Blair Benson's "Television Engineering Handbook" in the chapter on TV receiver design.

When the nation's major markets got "cabled" a large majority of viewers began t signals being maintained a level above visible noise, and below the overload leve receivers and as a result they vanished from later models.

So why am I telling you all this?

In one word: "Digital." DTV receiving appliances (receivers, downconverters, DVI been sacrificed for compact and low-cost tuners.

The NTIA minimum RF performance specifications were taken from ATSC docun signals other than NTSC and DTV.

No mention of FMI (my term for frequency modulated interference). As a matter c which was followed rigorously by the ATTC in 1995. Moreover, the FCC Rules co

So, in far off lands where downconverters are made, they design to the NTIA spe broadcasters.

We realized that in testing NTIA downconverters, which are small and inexpensiv FM signals. To the extent that DTV receivers have the same tuners, perhaps we

THE PORTLAND PROBLEM

Portland, Ore. has a very large percentage of homes receiving TV service by me local stations will use their former high band VHF analog channel for DTV, so if th

When Congress postponed the end of analog broadcasting it appeared at first th high band VHF channels would commence DTV broadcasting.

However, we devised a scheme by which laboratory testing could provide information concerning the robustness of DTV downconverters (and probably on DTV receivers too) before June.

Linley Gumm designed and built a high band VHF RF test bed, which augmented my UHF DTV test bed. We now have our answers from laboratory testing of 10 NTIA-approved DTV downconverters.

FMI may result when the DTV receiver is near one or more FM stations, hence receiving strong undesired signals while either at a distance from the desired DTV transmitter site, or where there is no direct ray path as behind a hill or large building.

FM/FM MHz	89.1	90.3	92.7	94.5	97.1	106.7
89.1	Ch.7					
90.3	Ch. 7	Ch. 8				
92.7	Ch. 8	Ch. 8	Ch. 8			
94.5	Ch. 8	Ch. 8	Ch. 9	Ch. 9		
97.1	Ch. 9	Ch. 9	Ch. 9	Ch. 9	Ch.10	
106.7	Ch.10	Ch.11	Ch.11	Ch.11	Ch.11	Ch.13

Fig. 2: Examples of FM interference into Channels 7-13

Fig. 2 shows how the second order distortion products generated in a receiver from six strong FM signals are distributed across the high band VHF channels.

Assuming that your post- transition channel is in the high band VHF region, you can analyze your station's situation concerning FMI by mimicking this example. Your table should not include FM stations whose signals are weak. I drew the line at –40 dBm.

Fig. 3 shows our results with the FM signals as received at my home roughly 14 miles or so from the FM towers in Portland.

Their total received power is –26 dBm, some 10 dB stronger than any DTV signal here.

The straight black line below the data plots has a slope of 2:1, which is the slope of second order distortion products. That is for a 10 dB increase in the signal causing the distortion, you get a 20 dB increase in the distortion. In Fig. 3, all of the performance data plots are parallel to this straight line with a slope of 2:1, which confirms that the effect shown is due to second order distortion products.

What Fig. 3 also shows, in my opinion, is a large range of robustness between different units tested. For example, at D = –80 dBm the worst unit will not function where the total FM power is greater than –31 dBm, while the best unit will work at –14 dBm.

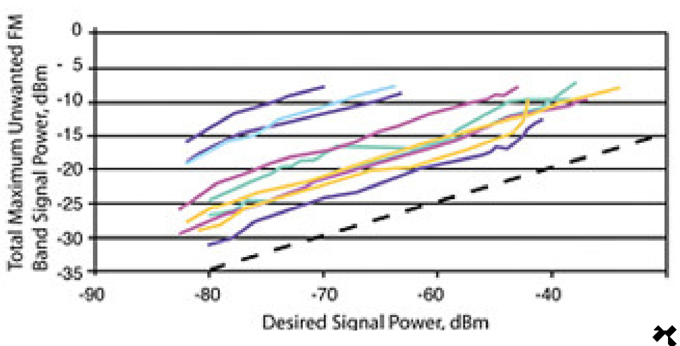

Fig.

Near the noise-limited desired signal power (–84 dBm according the FCC) these curves turn downwards because of the combination of receiver-generated noise plus the FMI. At –68 dBm, receiver-generated noise is negligible compared to the FMI so these curves have become remarkably straight. Some, but not all, curve upwards at higher desired signal powers. This is probably due to their RF AGC coming into play.

The good news is that FMI can be eliminated by installing a 75 ohm FM band stop filter at the input to the afflicted DTV receiving appliance. A much lower-cost alternative is a 75 ohm high pass filter (HPF) which attenuates FM signals and any low band VHF DTV signals. In many communities, there will be no DTV signals on Channels 2 through 6, so a high pa one or more DTV stations on low band channels. A way around this would be an desired.

That is so awkward that most viewers would pay the higher price for an FM band affect DTV reception of Channel 6. Clearly, experimentation is in order.

Stay tuned.

Charlie Rhodes is a consultant in the field of television broadcast technologies a

The Wire:
SMPTE Joins #GivingTuesday Movement With a Focus on Funding Stand
ChyronHego at Government Video Expo 2017

Comments