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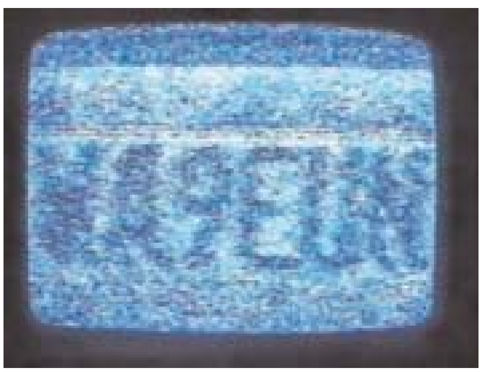

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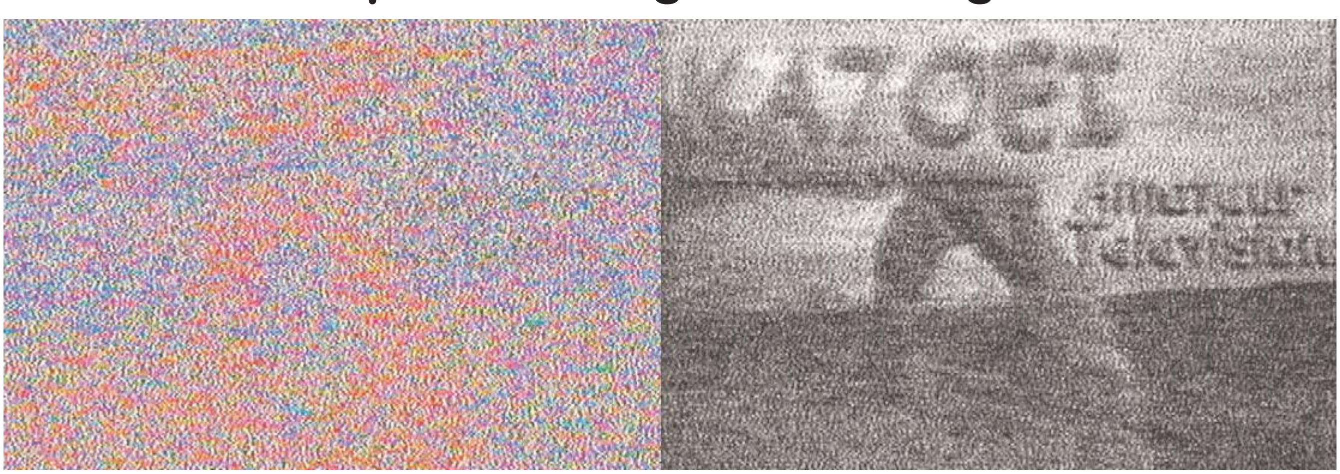

# AMATEUR TELEVISION QUARTERLY

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# Amateur Television Quarterly

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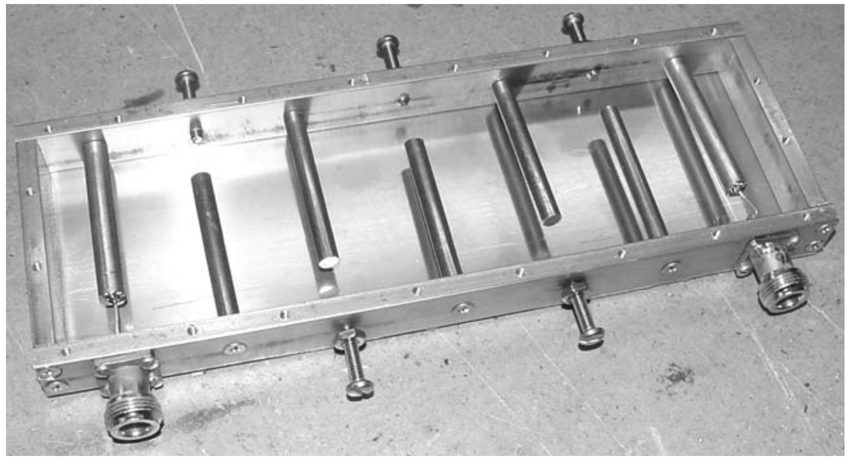
# ATVQ Notes

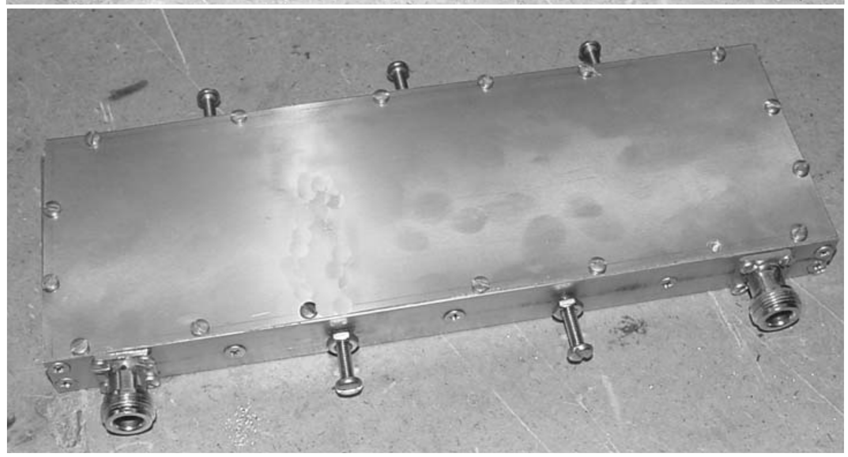
Dayton is almost here, and so much to do before then! It will be fun seeing many of you there. Make sure you stop by booth 308 and say hi. And, since I will not be able to get out much, make sure you tell me where all the good bargains are!

I had planned to have an article about my building the 1.2 GHz filter that Mike Collis, WA6SVT, wrote about in the last issue. I got it done, but not tested. I am waiting to hear from the person that lets me use his equipment to be able and check it out. I have a couple of pictures so you can see what it looks like.

This is the first time I have done much with working with metal, and I can already see where I can improve to make it look nicer. We all learn sometimes just by doing. It was a fun project, though hard to find materials. I had to order them out of Chicago area, but more on that when I write the article.

Gene Harlan - WB9MMM





# IF Bandpass Filtering Of AM TV Signals

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## Overview:

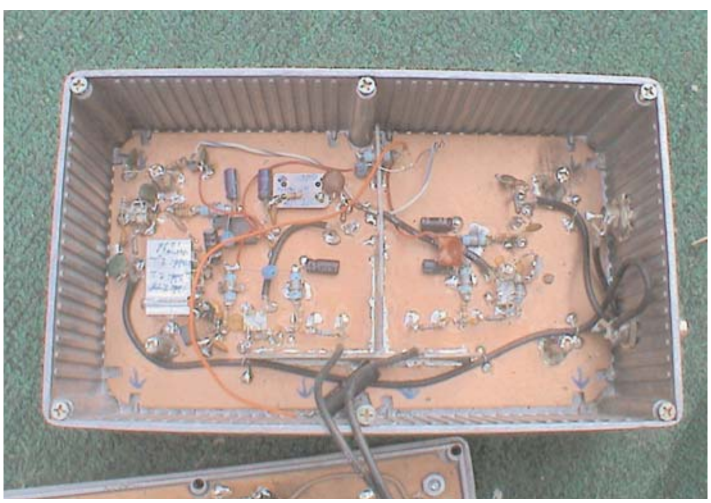
One of the most important components in any modern receive system is the bandwidth limiting component. Most often, this is a bandpass filter found in an IF (Intermediate Frequency) stage of the receive system. The characteristics of filter is arguably the factor that most dramatically determines the performance of the entire receive system in the presence of other signals and thermal noise.

It only makes sense that, the wider your filter, the more energy you will intercept. It also makes sense that if your filter is too narrow you may remove important portions of the signal you are receiving. For example, too narrow a bandpass filter on a video receiver may remove things like sound and/or color and cause inordinate degradation of video quality while too wide a filter may allow degradation from nearby signals as well as added contribution of system noise. Good receiver design implies that the filter bandwidth is a good match for the bandwidth of the received signal.

On Amateur Television repeaters - particularly on 70cm - the importance of good filtering is even more apparent. The repeater site is often shared with other transmitters that operate on “nearby” frequencies (perhaps even the repeater’s transmitter!) Even if not on-site, other 70cm transmitters in the geographical area may present the ATV receive system with strong adjacent signals as well.

Typical consumer-grade TV receivers employ SAW (Surface AcousticWave) filters in the IF to set the desired 6 MHz system bandwidth. While these filters provide excellent bandpass response characteristics, they are limited in their bandstop rejection - that is, the extent to which signals outside the filter’s response curve are attenuated. For SAW filters, this is typically in the region of 30-40db.

For TV usage, this filtering is good enough to provide adequate performance, even on a cable-TV system where there are adjacent channel signals present. These other signals, however, have carefully controlled signal levels and the various attributes of an analog TV signal ***(see sidebar)*** reduce the amount of energy that these adjacent signals put into various parts of the baseband of the received signal. On a shared spectrum resource (such as the 70cm amateur band) one may have the ATV signal amongst other (possibly much stronger) FM signals. In these instances, the 30db of stopband attenuation offered by the SAW filter in the demodulator may simply not be enough to keep those off-frequency carriers from degrading the received video.



## The Down/Up converter portion of the IF Filter Module:

This module performs its function by a combination of both schemes. ***Some*** filtering is done at the 45 MHz IF prior to downconversion. This “prefiltering” adds at least 20db to the performance of the existing SAW IF filter. A conversion is also done to a lower frequency where the “heavy duty” filtering is done at the lower (converted) IF frequency.

## Additional filtering:

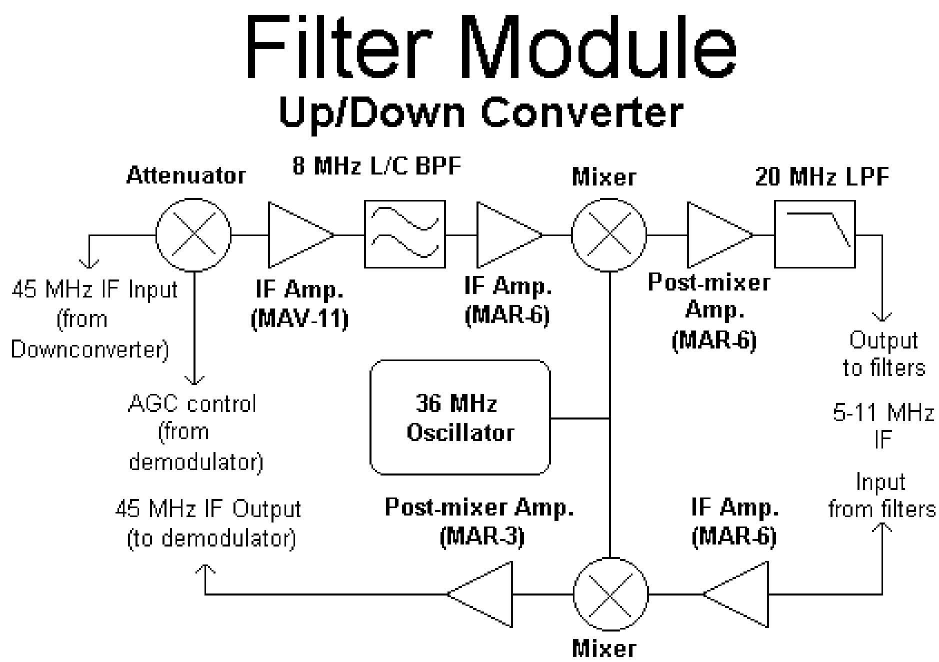
Because the WB7FID ATV repeater’s receiver is to be located at the repeater’s receive site atop a mountain with a lot of RF - ***and*** because it is the source of video for a repeater (that is, a lot of people will be seeing the output of this *one* receiver) it would make sense to make **this** receiver as good as we can make it. Since this receive system is modular (that is, it consists of a downconverter that is separate from the demodulator) it is relatively easy to insert additional signal processing modules into the IF line. The television IF frequency range spans from 41 to 47 MHz, with the video carrier being at 45.75 MHz - spectrally inverted, since the local oscillator operates 45.75 Mhz above the received signal.

There are several ways that an IF filter may be implemented:

- One may construct a filter with its components operating at the IF frequency component(s) of interest (e.g. in the 41-47 MHz range.)

- Another way to do the same filtering is to downconvert the 41-47 MHz frequency span to a lower range of frequencies where construction of filter elements is less complicated and component tolerances are less critical. Component Qs are much lower for the same effect, capacitors and coils are less lossy, allowing filter responses to be attained that may be impractical at higher frequencies. After the filtering, an identical conversion (except that it is reversed) is done to restore the signal to its original frequency.

As you have probably already guessed, the latter method was chosen.




### Description of the Up/Down converter section of the Filter Module:

***[Refer to block diagram]***

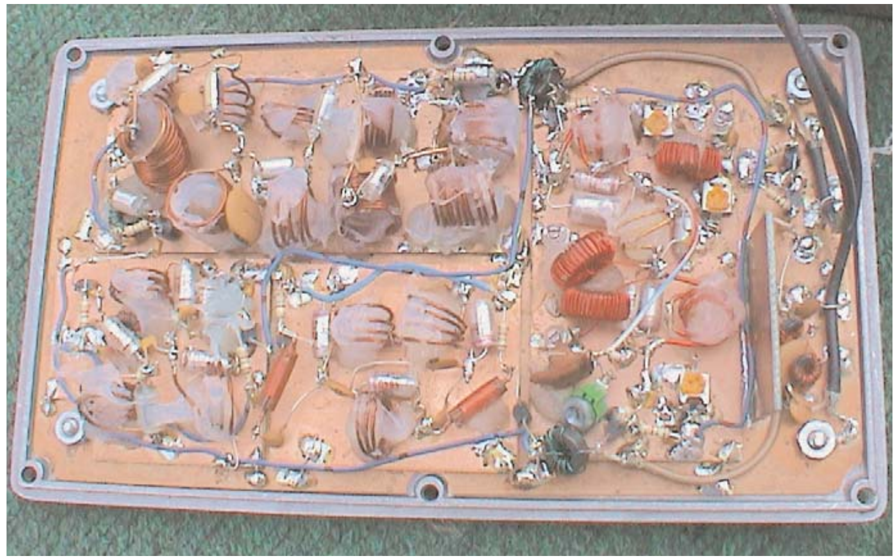
The 45 MHz video IF signal (from the downconverter) enters the filter module through the attenuator, a Mini-Circuits device: This is essentially a double-balanced mixer, but optimized for use as a low-distortion current-controlled attenuator. The AGC control for this device comes from the TV demodulator module and the AGC circuit helps preserve the dynamic range of the IF chain.

Following the attenuator is a MAV-11 MMIC. This provides about 13 db of signal gain as well as a source impedance for the 8 MHz L/C filter. This filter was extricated from an old VCR (one that was made before SAW filters were common) and has been modified to an 8 MHz bandwidth. (See the spectrum analyzer plot of this filter.) Note that this bandwidth is wider than the 6 MHz bandwidth of the SAW filter built into the demodulator - and this was done for a reason. Cascading two SAW filters had a nasty tendency to clip either the vestigial sideband of the video, or the sound (owing to rolloff - and the fact that no two SAW filters seem to be made exactly equally). Having the first filter being wider than the second alleviated this problem. It should be also be noted that this L/C filter presents a 25-30 db insertion loss - a figure that is comparable to SAW filters - thus requiring the additional amplification.

Following the bandpass filter is a MAR-6 MMIC. This amplifier provides a termination impedance for the filter as well as providing about 20 db of low-noise amplification to overcome the insertion loss of the bandpass filter. Following this amplifier is a Mini-Circuits JMS-11X doubly-balanced mixer. The local oscillator (a 36 MHz computer-type oscillator module) mixes the 41-47 MHz IF frequency bandpass down to 5-11 MHz. Following the mixer is yet another MAR-6 MMIC amplifier to provide mixer termination as well as to provide a bit of overall gain.

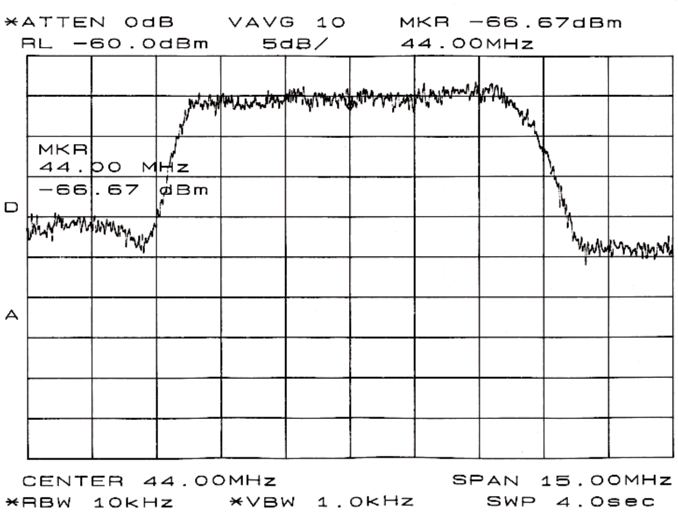
Note that the output of this mixer (and the amplifier) contains both the desired difference frequencies (5-11 MHz) as well as the undesired sum frequencies (77-83 MHz) and it is absolutely necessary to get rid of the latter. Failure to do so will result in another signal (also containing video) floating around that may (or may not) be passed by the various filter sections that might be added. Worse yet, this “other” signal, should it get through the filter sections, will have been affected differently (in terms of group delay and amplitude) and corrupt the video. A relatively simple 20 MHz 5 element Butterworth L/C lowpass filter easily attenuates this “image” (as well as any local oscillator bleedthrough) adequately. At this point, one has a version of the video converted to 5-11 MHz and further filtering *(described later)* may be applied as desired.

Once the filtering is done, it is time to convert the 5-11 MHz back to the 45 MHz IF. The 5-11 MHz signals (after having been filtered - or not...) are amplified by a MAR-6 MMIC (to overcome insertion loss incurred by the filtering) and applied to another JMS-11X mixer. Because the 5-11 MHz frequency range is well below the rated frequency range of the mixer, the IF input of the mixer is used rather than the more "traditional" RF port. This mixer, using the same 36 MHz local oscillator used to perform the downconversion, translates the 5-11 MHz IF back to the 41-47 MHz IF that the demodulator can use. Following the mixer is a MAR-3 MMIC amplifier which provides further amplification as well as termination of the mixer's output.



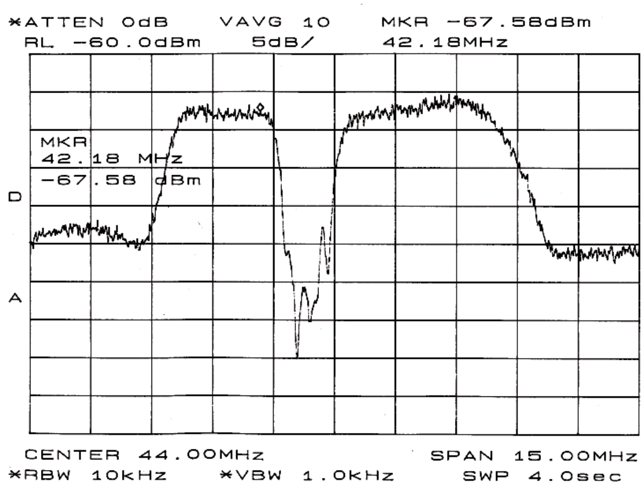
*Bandpass/notch filter modules of the IF Filter Module*

It is worth noting that the upconversion also results in the generation of two undesired signals: A 25-31 MHz image as well as bleedthrough of the 36 MHz local oscillator signal. As it turns out, the SAW-based filtering in the demodulator itself is more than adequate to prevent the 25-31 MHz image from causing any measurable degradation of the demodulated video. The 36 MHz bleedthrough, however, is a different story: Even though the balance of the mixer keeps this signal about 30 db below the level present on the local oscillator input pin, after amplification, the result is a very strong signal compared to the video. To combat this, a small trimmer capacitor and trimmer potentiometer are "wrapped around" the mixer, from the local oscillator input pin to the "output" pin (which is really the RF [input] pin, as we are actually putting our signal on the IF [output] pin of the mixer). Careful adjustment of these two components allow a means of canceling the LO bleedthrough and thus an additional 25-30 db of nulling of the 36 MHz signal (without affecting the video, as an L/C filter might do) putting this signal well below a level that might "bother" the demodulator.




***Spectrum analyzer plot of the filter module in the "passthrough" mode. Vertical divisions are 5 db and horizontal divisions are 1.5 MHz. This plot represents the response of the 8 MHz L/C filter in the module. Note: Each analyzer plot is done at the output of the filter. Remember that additional filtering is done in the 5-11 MHz range and these plots reflect the down/upconversion.***

Why use 5-11 MHz? Why not lower? The choice of 5-11 MHz was made because a 36 MHz "computer type" crystal oscillator is readily available. Another factor to consider is that putting the local oscillator "closer" to the IF (thereby moving the converted IF "lower" in frequency) would have placed the "upconverted" image (the 25-31 MHz signal mentioned above) even




***Spectrum analyzer plot of the filter module in the "notch" mode. The notch is approximately 1.5 MHz wide. This "notch" leaves intact most of the chroma (color) and the sound carrier, but only allows the bottom 1.7 MHz of the "luma" (black and white) portion of the video to get through.***

closer to the original 41-47 MHz passband, potentially making it a source of signal degradation.

## Using the "new" IF:

Now that we have this "new" IF, what do we do with it? First, let's calculate where our critical spectral components will be.

| |
|---|
| ●"Bottom" of video: 11.00 MHz (1.25 MHz "below" the video carrier, originally at 47.00 MHz) |
| ●Video carrier: 9.75 MHz (Originally at 45.75 MHz) |
| ●Chroma (color) carrier: 6.17 MHz (3.58 MHz "above" the video carrier, originally at 42.17 MHz) |
| ●Sound carrier: 5.25 MHz (4.5 MHz "above" the video carrier, originally at 41.25 MHz) |
| ●"Top" of video passband: 5.00 MHz (4.75 MHz "above" the video carrier, originally at 41.00 MHz) |

Remember: The 45 MHz video IF is spectrally inverted because a high-side local oscillator is used on the 70cm downconverter and since a low-side local oscillator is used to get it down to 5-11 MHz, it is still inverted. This explains why the "higher" video baseband frequencies are lower in the IF passband.

Let us further analyze what we know about the video signal.

| |
|---|
| ●Most of the energy is contained within the first several hundred KHz of the video carrier. |
| ●Eliminating certain components (such as sound or color) will still yield usable video, minus the sound or color, of course. |
| ●Higher frequency video components may be eliminated if display resolution may be sacrificed. The resulting narrower detection bandwidth will result in better signal/noise ratios, possibly making unusably weak signals more visible. |

With these points in mind, several filters were designed.

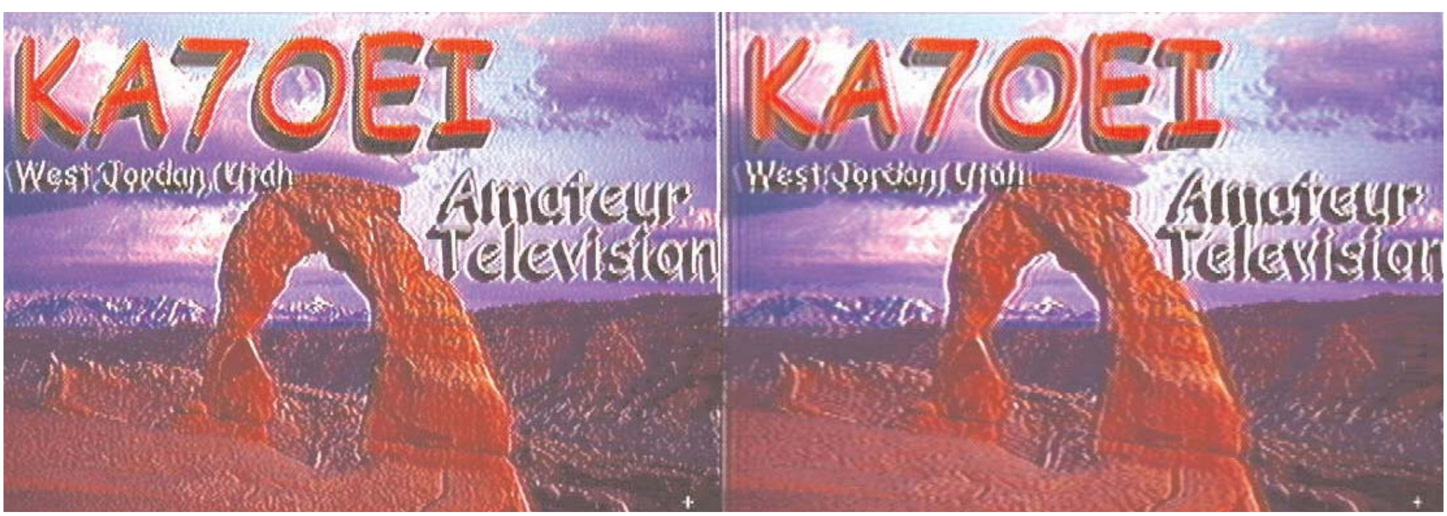
## The "Notch" filter:

Referring to the spectrum analyzer plot (Note: Vertical is 5 db/division and the horizontal is 1.5 MHz per division,) you can see why this filter is so-named. Approximately 1.5 MHz of the active video spectrum - from just "below" the chroma to the "upper" part of the luma has been attenuated by at least 20db. Does this "trash" the video? The answer is: Not really. Looking carefully at the picture, one can see that the "critical" video components are left intact. The sound is still there, but the "lower" edge of the chroma passband has been removed (remembering that the IF of the video signal is inverted, so the "lower" video frequencies are to the left [i.e. higher] on the plot). The notch extends down to approximately the 1.7 MHz point in the luminance bandwidth.

What ***does*** happen to the video, then? Surprisingly little, actually. The two side-by-side images demonstrate the effects. Careful comparison of the two images will reveal that there are some subtle differences. The "unfiltered video" (on the left) is somewhat sharper than the "notch filtered video" on the right. This is a natural result of the fact that we are eliminating the very components that make up the fine details in the image. The color is also slightly "smeared" due to the fact that we have eliminated a portion of its bandwidth as well.

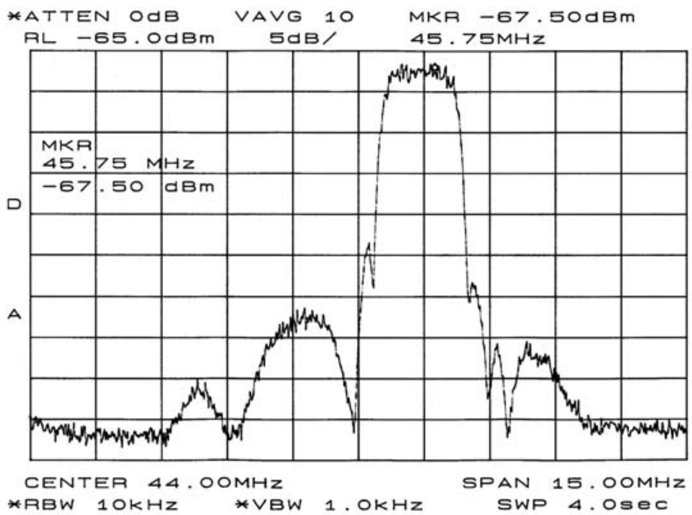
Additionally, there some artifacts that may be seen to the right of sharper lines that are a result of the group delay characteristics of the notch filter itself (and possibly some "ringing" in some part of the circuit). It is certainly true that with very careful design and attention to detail, these "group delay" effects may be reduced or even eliminated, but (as those of you that are familiar with design of video equipment know) the complexity of the "delay equalization" portion of the filter will likely on par with that of the filter itself. Perhaps it will be done another day...

Interestingly, if you look carefully you will notice that the "notch" image has a bit less noise than the "original" image. Why? As it turns out, much what is perceived of as noise in the video is noise energy in the higher-frequency portion of the luminance. Since this filter effectively eliminates much of the high frequency content of the video, this noise is significantly reduced. This leads to another important point. For a given signal strength, the signal-to-noise ratio of a received signal is directly related to the receiver's bandwidth. The wider the




***The "original" video signal (left) and the "notch filtered" video signal (right).***

bandwidth, the more noise one is likely to pick up. In the case of the "original" video signal, we can assume that we have the usual 6 MHz video bandwidth. In the case of the "notched" signal, we eliminated 1.5 MHz of that 6 MHz yielding a bandwidth of only 4.5 MHz total.




***Spectrum analyzer plot of the "1 MHz" filter. This is so-called because the passband extends 1 MHz "up" from the video carrier.***

Now, this is kind of misleading, as a typical television receiver only uses, at most, about 5.5 MHz of that (the luminance and chroma go only up as far as 4.2 MHz, and the IF filter cuts off a bit of the lower vestigial sideband) so in reality, we end up with about 4 MHz with the "notch" in place. The elimination of this 1.5 MHz results in a signal/noise ratio improvement of about 1.4 db from the bandwidth reduction alone. If there were other signals in that "notch" (such as FM repeater inputs and outputs) then the apparent improvement in the signal/noise ratio could be ***far*** greater.

## The 1 MHz filter:

Referring to the spectrum analyzer plot (the same parameters apply as for the previous plots) one can see that this is a 1.5 MHz wide bandpass filter. Why is it called a 1 MHz filter then? While the filter is 1.5 MHz wide, 500 KHz of it falls below the video carrier while the other 1 MHz of it is above the carrier and because of this, it will pass luminance information up to 1 MHz. Notice that it effectively removes all color and sound as well.

Why would we want to do this? This goes back to that video bandwidth stuff, again. Assuming that we have about 5.5 MHz of video bandwidth on a "normal" signal, if we reduce it to 1.5 MHz, we get a theoretical signal/noise ratio improvement of about 5.6 db! This is approximately the equivalent of increasing transmitter power from 10 watts to about 35 watts! This, too, may be a bit misleading owing to the way the eye interprets and processes noise. As a signal weakens, the high frequency noise components seem to appear first, imbuing the picture with "fine grained" noise. By removing the high frequency components, the noise that remains doesn't contain the high frequency energy that it otherwise would and thus, it may look less-noisy that it otherwise would be.

What does this gain us? A 6 db improvement can turn a signal that is so weak that all you see is sync bars into a signal where a large, full screen ID may be just visible.


***Video through the "1 MHz" filter. Note that color information as well as picture detail is lost. (Well, of course it is in the magazine! - Ed)***

Doing this filtering exacts a price. The picture demonstrates that all color is lost. From the analyzer plot one can infer that the sound is gone, too *(but more on this later...)* Additionally, even more of the fine detail has been lost. Looking closely at the picture, one can also see the effects on the video caused by the lack of equalization to compensate for the variation in the group delay across the filter's bandwidth. As in the "notch" filter, these effects manifest themselves as "echoes" to the right of some of the picture elements.

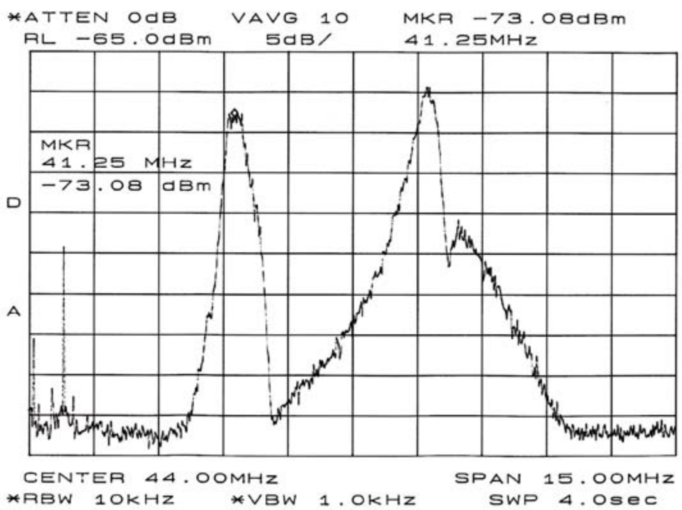
Prior to constructing this filter module various tests were done at the original 45 MHz IF to determine the feasibility of constructing filters at that frequency. While it is perfectly possible to build such filters, extreme care must be taken to assure high filter Q and frequency stability. As it turns out, building simple notch filters at 45 MHz is easy, but building steep-sided bandpass (or bandstop) filters that have a "flat" bandpass (or bandstop) over a given bandwidth is not. The "steeper" the filters sides are, the higher Q that is required and getting a suitably high Q from a filter element at this frequency may require that it be physically large.

In the 5-11 MHz frequency range, even though higher values of inductance and capacitance are used, getting the sorts of high Q's required at the higher frequencies isn't necessary, being a lower frequency implies that the "steepness factor" is much less severe. For example, if you wanted to build a bandpass filter that went from 3db to 20db attenuation in a 500 KHz span, this would require a "steepness" factor of 15 if the filter were built at

7.5 MHz. Building the same filter at, say, 43.5 MHz, would require a "steepness" factor of 87 - a factor of 5.8 more stringent.

## The 300 KHz Filter and the "Sound-pass" filter:

The last filter section could be considered a "DX Mode" filter. This filter has a bandwidth of approximately 500 KHz, with 300 KHz of that residing "above" the video carrier. Assuming a "video" bandwidth of 5.5 MHz for a "normal" demodulator, this represents an improvement of about 10.4 db. This can, quite literally, turn a undetectable sub-P0 video signal into one where a large, full-screen ID may be copied!




***Spectrum analyzer plot of the "300 KHz" filter as well as the "sound-pass" filter. A 300 KHz wide bandpass filter approximately centered on the video carrier limits the luminance bandwidth to 300 KHz. Additionally, a second bandpass filter allows passage of the aural (sound) carrier.***

As is the case of the other filters, one must sacrifice several things. Chroma (color) is out of the question, the sound is gone, and the resolution of the video is very poor. But, as can be seen from the picture, it is very usable if the picture contains some very large (i.e. low-bandwidth) components such as a large ID.

The spectrum analyzer plot not only shows the "300 KHz" filter (toward the right of the plot) but a second bandpass filter response is shown (on the left of the plot) that is designed to pass the aural (sound) carrier. This is actually a separate filter (about 300 KHz wide) that may be switched in and out as desired. This filter is designed to be used in conjunction with the "1 MHz" filter to permit sound reception with it as well.

You may ask, "Doesn't turning on the sound filter 'noise-up' the picture?" The answer is, not much. For the most part, the frequencies around the sound carrier are already removed by the demodulator to prevent the presence of the sound carrier from "fuzzing up" the picture. What does get through can be easily removed with a low pass filter on the video output of the demodulator.


***Video as seen through the "300 KHz" filter. Note that although this picture is quite "fuzzy" a surprising amount of detail is visible.***

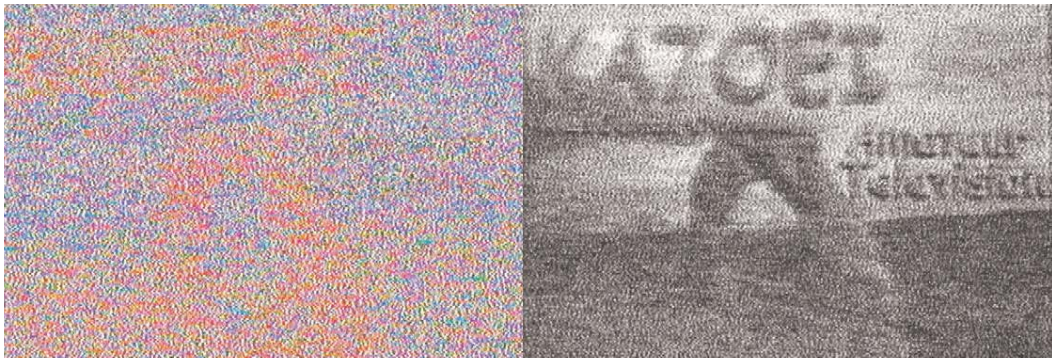
## I.F. Filtering versus Baseband Filtering:

You may be asking yourself, "Self, this is a lot of trouble to go through to filter out parts of the video. Wouldn't it be a lot easier to do this ***after*** it has been demodulated?"

This is a good question to ask, so we'll look at it for a moment. In an ideal demodulator, we simply recover the information in the sidebands. End of story. The demodulator doesn't really care whether there is one sideband, or two (ignoring the amplitude of the demodulator's output for the moment) or just a portion of a sideband (as is the case for standard AM video).

In the old days, envelope detectors were used for video detection. This is essentially an RF detector where the output of the detector is in direct proportion with the RF voltage going in. A stronger signal results in more voltage out and a weaker signal results in less voltage and to work properly, this type of detector requires that the video carrier be intact. Nowadays, the vast majority of analog televisions use a synchronous detector. This is a big improvement over the envelope detector for several reasons: An envelope detector needs a good video carrier to work properly. One problem is that, as the entire video signal gets weak, the video carrier gets weaker (and noisier) as well. With the video carrier getting noisy, it adds to the noise that is already in the video from the rest of the signal being weak, making the video appear noisier than it really is.

A synchronous detector, on the other hand, takes the received video carrier and reconstructs it. It can do this because, as it turns out, the video carrier can be received even if it may be very weak because the circuit that recovers it has a narrower bandwidth than the video detector itself. This is the same sort of situation where you know that there is a video signal on frequency, but you cannot see it on your TV, even though you can hear it on your FM receiver just fine. This happens because your FM rig has only about 15 KHz bandwidth as compared to



***Comparing a very noisy signal received with full bandwidth (left) with the "300 KHz" filter (right.)   Note that the low bandwidth signal is essentially uncopiable whereas larger-sized details may be seen in the 300Khz-filtered signal.***

the 6000 KHz (or thereabouts) bandwidth of the video receiver. With the video carrier "regenerated" within the detector, we now have a "pristine" copy of the carrier that we may use to demodulate the video. As it turns out, synchronous demodulators produce pictures that are 6db less-noisy for a given signal than an envelope detector. This would be equivalent to the transmitter increasing its power by a factor of 4! There is a separate circuit called the AGC (Automatic Gain Control) that is also involved. This circuit looks at the amount of RF going into the detector and if it is greater than a preset level, it reduces the gain of the RF amplifiers (these amplifiers may be in the RF front end and/or in the IF stages) and if the RF level is lower than a preset level, it will increase the the gain. The whole purpose of this circuit is to keep the RF level constant. (I'll mention briefly that there are also some circuits built into the AGC to look only at certain parts of the video so that the AGC doesn't go up and down with the brightness of the picture). If this AGC weren't present, then a weak signal would have a vastly different brightness than a strong signal.

Now, what do these things have to do with filtering? As it turns out, if the demodulator were perfect, we could simply put, say, a 300 KHz lowpass filter on the video output and get reasonable results. If you do that, however, you might note that the demodulator is still "seeing" the entire 6 MHz of IF passband. The rest of this IF could be filled with noise - or other 70cm signals. The presence of any other signals in the video output can cause picture degradation (even if you would seem to be filtering them out) because of non-linearities in the demodulator. If these other signals are strong you may simply overload the demodulator.

What about the AGC then? As it turns out, if you are using the video lowpass filter, the demodulator's AGC will do its job. If there is a strong signal in the passband, the AGC will reduce the gain of the receiver, possibly to the point where the weak signal you are trying to copy is simply gone! If the filter is in the IF, on the other hand, then that interfering signal will never even get to the demodulator. Problem solved. A similar thing goes for noise, as well. A well-designed video receiver will be doing a little bit of AGC action just on the noise of an empty channel (note that I said "a little" bit of AGC - any more than that will compromise your receive system's dynamic range). If you have the full 6 MHz of bandwidth then your AGC is causing the gain of the receive system to be throttled back just a bit on the entire 6 MHz of noise. Now, if you have the "300 KHz" filter (described above) then the AGC is not acting on the noise of the entire 6 MHz and is now running at higher gain.

Let's look at it another way. If you consider that your ATV receive system has a noise figure of, say, 5 db (this isn't really too bad - this would be typical if you had a GaAsFET downconverter and 3-4 db of coax loss) then the minimum discernible signal that you are going to see on your TV is going to be in the area of 2 microvolts or so. This signal is weak enough that all you'll probably see are sync bars and not anything that you'll be able to recognize. Now if we were to drop the IF bandwidth of the TV from the normal 6 MHz to 500 KHz (as in the case of the "300 KHz" filter above) then our sensitivity actually increases. It will not take only about 0.7 microvolts (or less) to see the same sort of signal that you could "see" with 2 microvolts and the normal 6 MHz IF. The effects of this filtering can clearly be seen in the split image. The left half of the image shows a signal just barely at the threshold of the demodulator maintaining sync on the picture while the right half shows the same signal at the same signal strength, but with the "300 KHz" filter switched in.

***An even weaker signal viewed through the "300 KHz" filter. This signal was completely undetectable at the full 6 MHz bandwidth. Even though it is very noisy, the large ID is just barely legible!***

An (possibly) even more dramatic demonstration may be with the other picture. In this case the signal was not even detectable (i.e. no sync bars visible at all!) in the full 6 MHz bandwidth. Even though it is very noisy, the large ID is still legible (albeit with some difficulty).

## Conclusions:

The “filter module” idea originally started out as an “I wonder how it well it would work if...” concept and has developed into what it is now through a bit of number-crunching and experimentation.. While we have yet to put this portion of the repeater “on the air” the workbench “simulations” look very encouraging.

There is little doubt that this can be improved upon. A bit of effort to provide group-delay equalization in the “Notch” and “1 MHz” filters would likely reduce the filters’ artifacts. A bit of high-frequency pre-emphasis could also be applied to the video to make the 1 MHz and 300 KHz video “appear” to be sharper. It may be worth looking into an “ultra narrow” mode (about 50-100 KHz of video bandwidth) - just to see how narrow it could be and still be useful.

In our application these filters are going to be remotely switchable. Each filter section is selected via PIN diodes so there are no relays to wear out. One idea that has been tossed around is that, when the repeater is “idle” it will default to the “300 KHz” filter. Upon detection of sync, it may “automatically” select which filter it will use, based on the received signal strength (after calibration, of course!) but any filter setting could be overridden remotely should we wish to make our own decisions.

ATVQ



## Spectral Density of Analog TV Signals

It should be no secret that the majority of transmitted power in an analog video signal is contained within several hundred KHz of the video carrier. In fact, the other components that contain significant power are the chroma (color) carrier (with, at most, 15% of total power) and the sound (typically with 5% or less of the total power).

The fact that these other components are so much weaker makes them less prone to interfere with an adjacent channel signal. It also helps one understand why, on a cable system, it is important to make sure adjacent cable channels are well matched in terms of their signal strengths.

There are other implications as well. Even though the video components that are farther removed from the carrier are quite weak (as compared to the carrier itself), they carry things like color, sound, and the fine detail (i.e. resolution) of the picture. The “weakness” of these components also makes them the first to suffer degradation when signals are weak. It also should be no surprise that these same spectral components are most easily affected by interference from other sources.

## Comment:

When video is noisy, the “noise dots” tend to move around randomly. This allows the eye and brain to “average” a lot of noise out of the picture. Because of this, the noisier pictures shown actually look better than they appear as frozen images. To test this yourself, record some noisy video on your VCR and then freeze-frame it.

What does all of this mean? It means: No, the video does not look as bad as these still images would lead you to believe.

# New Catalog From ATV Research

A FREE copy of the No. 2004A Spring-Summer Edition of the ATV Research Video Wholesale Catalog is now available.

This issue is heavily devoted to Homeland CCTV Security and features a wide selection of new, high sensitivity, day-night cameras (with and without built-in IR lights), digital recorders, networking systems, covert systems, and much more.

Contact: Scott Shadbolt or Kevin McClain
Phone: 800-392-3922 or 402-987-3771
Fax: 402-987-3709
Email: catalog@atvresearch.com
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ATVQ

# Midwest ATV DX Report

**By: Bob Delaney - KA9UVY - Email KA9UVY@hotmail.com**
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**DX Hotline 618-242-7063**

Since this report covers the worst months for ATV DXing, the reports are few, and DX is minimal as expected. I would once again remind everyone to please send me reports of any DX you might experience so that we might all share in your experience.

I would also like to make an announcement that should excite any ATV DX enthusiast. WA9EUN, Dwight, of Plano, IL. has constructed what I believe is the first ATV amplifier to employ the Russian GS35B. This tube is a very affordable alternative than the usual QRO tubes used for video in the past. Dwight did give me some information to share with ATVQ at this time and if enough interest is out there maybe an article could be in the future!

The design is similar to ones posted on the web at **http://www.nd2x.net/.** There are some changes that you will need to make for it to work properly on ATV, but he assures me that it is not difficult. Here are a few details he shared with me about the amp:

**·Grounded grid GS35B Triode**
**·Tube Dimensions 7-1/2" h x 4" Dia, weight 6.2#**
**·Amplifier Gain is 10 db, 100in =1000 out 6mhz bandwidth**
**·No socket required, Grid ring is clamped to chassis with six "S" shaped clamps**
**·Requires minimal air cooling (150cfm), cooler removable for water cooling**
**·Temperature compensated for thermal drift using strip line design**
**·Power requirements 3500 volts @1 amp**
**·Currently using video modulated 4cx250B to drive the GS35B amplifier**

Also a word of caution: The output of this amp has so much current that it will melt or burn out N-connectors. Dwight found that a silver teflon PL-259 was able to carry the high current and couples the amp to the hardline without failure.

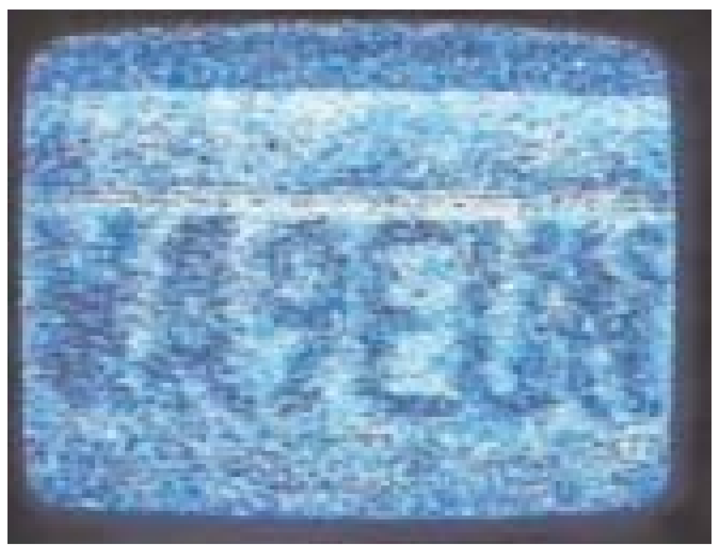
Want to learn more?? Please send an e-mail to me and if enough feedback is received Dwight says that the information will be made available. There are several of these new Amps being built in the Chicago area and if you are working DX this summer I am sure you will see one on the air.

Now on with the reports:

**01/13/04 03:00z- 05:00z**
KB9CJR, Tony, of Bollingbrook, IL. reports that he and some of the other N. Illinois ATV DX operators worked several low power stations in the Southern Wisconsin and Ft. Wayne IN areas.

**02/27/04**
Many stations were worked from S. Illinois with signals increasing in strength by morning 02/28. K9KKL, N9XHU in Springfield, IL. about 100 mi. and KB9WLM in Canton, IL. (169 mi.). Also, the several MO. stations were worked at or around 100mi. including K0PFX, KO0Z, W0DQY, and NI0D. Some signals reached P-2 with 15 watts and P-3+ with 50-100 watts. This opening was forecast by Hepburn!

**03/03/04**
WA9EUN, Dwight, of Plano, IL. (240 mi.) managed P-2 video into S. Illinois with dead band conditions. This was our second scheduled attempt with only sync bars on the first. Dwight's signal had the usual Tropo scatter fluctuations and it is important to note that there was no opening or ducting. Just pure Brute Force and determination. He was running legal limit with his GS35B amplifier mentioned above and 4 - 21 el. yagis @ 97'. This was a 1-way reception of his signal and no 2-way was attempted.



**03/09/04 01:00-01:50z**
W9ZIH, Ron of Malta, IL (252 mi.) receIved here P-2
NK9M, Bob of Oswego, IL (234 mi.) just below P-1
WA9EUN, Dwight of Plano, IL (236 mi.)
I receIved KA9UVY, but did not transmit this evening. No two-way contacts were completed but band conditions not that good! All accomplished with a schedule on 144.310 ssb talkback.

**03/25/04**
Note of interest WA9EUN and KA9UVY have run several skeds at 7:00pm local time. WA9EUN has made at least P-1 video every time except our first attempt. That's 240 Miles under dead band conditions every day!

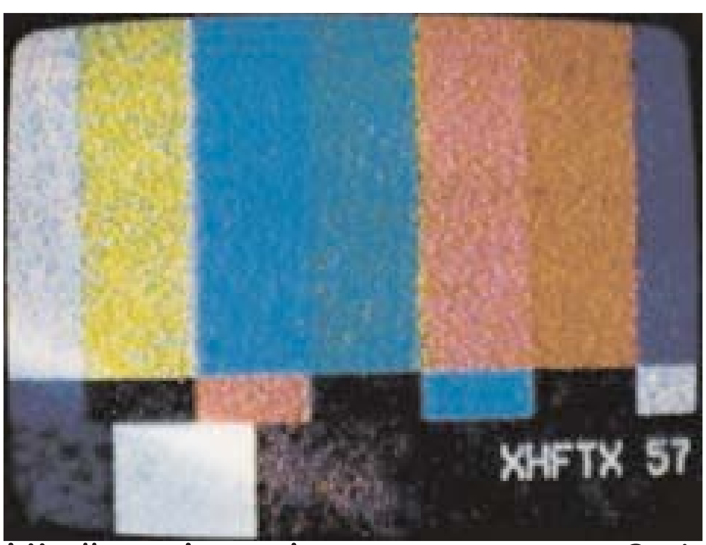
## DX Tip: Overcoming our Biggest Obstacle

This year I celebrate my 10th year operating ATV and most of that time devoted to DXing. I will be the first to admit that DX is and always will be the part of ATV that I enjoy the most.

In fact if you have ever talked to me you know that I will try and push your interest in the same direction. Many times I have mentioned ATV and ATV DXing to others who were curious about ATV and some who have tried ATV and not been very successful only to hear negative statements from them about this mode. Instead of an actual operating tip for this columns run I think it best to tackle some of the myths that are out there about ATV and ATV DXing. With a CAN DO attitude and heads-up operating practices you can be a very successful ATV DX operator. It seems our biggest obstacle is within our minds.

**MYTH :** ATV, oh that's on UHF and you can't get across town on UHF.

**FACT:** UHF, has a limited operating range as does all VHF radio work. Although UHF point to point path losses are a bit higher UHF lends itself to unique propagation modes that can, and do extend range to thousands of miles. Here in the midwest


I think that around a thousand miles is very possible and I offer this picture of Channel 48 KNVO in Brownsville, TX. @ 996 mi. and Ch 57 XHFTX out of Mexico as examples of UHF ducting into S. Illinois.

These are broadcast TV stations and I can't recall the ERP of them at the time I took these photos but I am sure it was more that the average ATV station. However, the real factor that made this reception possible is Tropospheric Ducting and the fact they were on the air and I was looking!

**MYTH:** I don't have a hundred foot tower or high power so I can't DX ATV.

**FACT:** Having a 100' tower and high power almost always helps extend your range on ATV but is not something you must have to get DX. Many contacts out to 300 miles or more are made with only a 10 watt TX and single yagi. Your height above average terrain makes a great deal of difference on your daily ATV range but during ducting events you will find that it doesn't matter much. I can remember getting CH 16 out of Little Rock, Arkansas during an opening and while changing antennas having them P-4 with me as the antenna touching the screws on the back of the set. I don't believe my body has much gain on UHF and I am only 5'11" tall !

Also if you look in past ATVQ's you can see that during the ATV contest N9XHU in Springfield IL put in a very nice P-3 picture to W8ZCF in Cincinnati, OH. on low power, about 6 watts @ 286 miles. Also yours truly managed a 2-way with KC0HFL in Wichita, KS. @ 461 miles with my antenna at 68 feet. That's 22 miles further than I ever got with my antenna at 110 feet.

**MYTH:** If I can't hear you on 2 meters there's no use in trying video.

**FACT:** Expecting 400 Mhz to behave like 144 Mhz is just old school thinking. I have studied this subject carefully and can tell you this is not so.

Many times I have been working a station on ATV and they have simply faded out on 144 Mhz while the video remained. Other times I have had to use the phone to give the report because 144 just wasn't open while 400 was.

Tropospheric conditions can vary greatly with frequency and height above ground. Many times openings start out at higher freq and as they intensify crawl down. Sometimes it works the other way and starts out low and crawls up in freq.

There is one thing in the World of ATV I can tell you is:

## FACT: IF you don't try you certainly won't make it!

ATVQ

# Emulating The Sinclair ZX Spectrum on a PC

By Paul Godfrey G8JBD Email:paulgodfrey@3lowry.fsnet.co.uk
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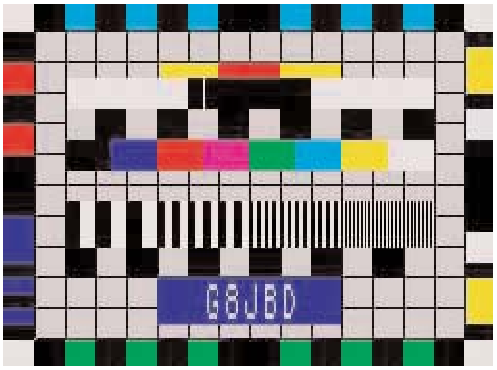



## Introduction

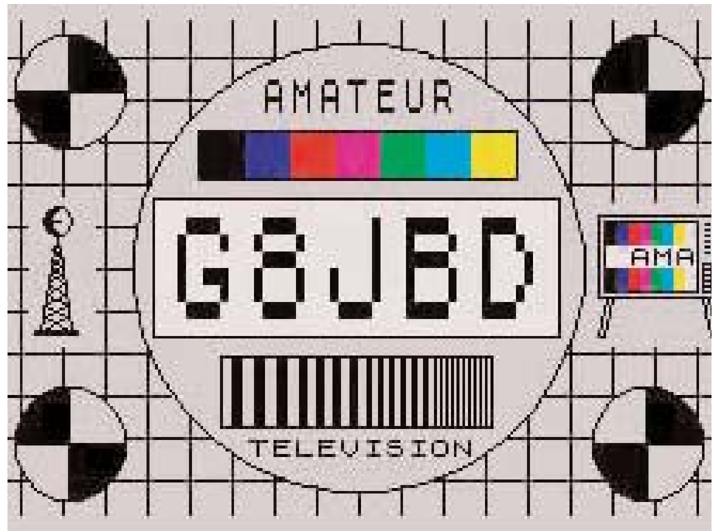
I became interested in ATV in about 1980. Domestic sources of video signals were becoming plentiful, VCRs, cameras and then microcomputers. Here in the UK the government of the day decreed that every classroom in the country would have a computer and parents were also looking at the various offerings so they could help educate their child. I was whipped along in this frenzy and purchased a Sinclair ZX Spectrum (I believe in the US these were marketed under the Timex brand name) for the education of my children. Many articles and programs were written for and about it. Radio Hams also became interested in the machine and several projects and programs were written, some of which were in CQ-TV and other BATC publications. It soon became clear, in my case that this new equipment was not so much educational, but in the hands of my children, a video games platform and Hungry Horace along with Jet Set Willy seemed to be permanently displayed on the screen. I purchased the ATV program and later the New ATV program from The Worthing Video Repeater Group. This excellent piece of software for the Sinclair ZX Spectrum was written by Robin Stephens G8 XEU, it could generate testcards, calculate distances using QRA locator and much more. But the Spectrum never made it to my radio shack because of the high level of demand from my children. Eventually the Spectrum was ousted by a Commodore Amiga and was put in a cupboard along with the software.

## 20 years later

Now nearly 20 years later there is a PC in my shack. I began looking on the internet and put the words ZX Spectrum into a search engine and was greeted with loads of links to sites offering a variety of things from emulators to software as well as nostalgic looks back at the fairly recent past. One site **www.cdworld.co.uk/mmcd/speccy.html** was offering a CD for sale, The World of Spectrum, with programs and emulators for a cost of £5. I sent off for it and was impressed by the large quantity of software on this CD. All of the emulators are DOS except one and are not zipped, so they can be run straight from the CD, which means that you do not have to loose hard disc space to use the disc. I was able to run all the emulators with an old 486 100MHz, so the latest and greatest PC is not necessary. As well as the DOS emulators on the CD there is also ZX32, a Windows Spectrum emulator, written by Vaggelis Kapartzianis, this program is excellent and also runs on a 486/100 MHz. You can also download this program from **www.geocities.com/Siliconvalley/bay/9932/** free of charge. The World of Spectrum disc contains thousands old Spectrum games and demos as well as several rewrites of games that run on a PC without the use of an emulator. It is a good attempt at cataloguing the history of Spectrum software and a second disc is available for a further £5 that contains the endings of games and scanned images of cassette case inserts and Spectrum magazines of the era. All the old games and demos that my children had, seemed to be on it, but not the Worthing ATV Program. I began to think that it would be nice to use this program again and my old copies were dug out. The original software is on cassette tape and none of the emulators on the disc seemed to support cassette tape loading. The program files on the disc are in various converted formats such as .sna .tap and .zip. I needed a Spectrum emulator that my tape file would load into and convert to one of these formats. Another look on an Internet search engine found **www.methedrine.demon.co.uk** this site offered SpecX a ZX Spectrum emulator for the PC. Minimum requirements Pentium 133 with Direct X. This emulator works in Windows 95/98/NT (I have no idea if it will run in Windows 2000 or XP) as a Windows program rather than a DOS program running in Windows. I downloaded a shareware copy. The shareware version only runs for 10 minutes before it times out and it then has to be reloaded. Sending SpecX's author Robin Edwards a registration fee of £10 will result in you receiving a code that gives a full working version with no time-out.

## Loading Tapes into SpecX

First of all the tape must be turned into a .wav file Windows sound recorder will do this although I used Crystal Audio Station by Voyetra. Simply connect a mono cassette recorder to the mic input of your sound card play the tape and record the sound. Some adjustment of the audio level of the cassette recorder output and the input to the PC is necessary. Once this is done record the Spectrum tape and save it as a .wav file. Then load up SpecX. Type J then Ctrl PP, this will bring up the old familiar "LOAD." Click on File and Open Snapshot, then locate your saved .wav file and open that. click on File, then Tape Control and set the sampling frequency to the same value as your saved .wav file, I used 22050 Hz. You can stop, rewind and play your virtual tape. If all is well you will see the software loading in the border just like a real Spectrum. Most programs run when loaded just like the old Worthing program. You can now save your software as a snapshot on the File menu save option. The saved file will then work with


any of the emulators on The World of Spectrum CD including ZX 32.

## Free Downloads

Since the publication of a version of this article in the August 2002 edition of CQ-TV, you do not have to do any of the above if you wish to use the Worthing ATV Program. The CQ-TV web site has a folder on it that I compiled, available for free download containing Spec X and the Worthing Group ATV Program converted to .sna format along with the original program notes. Please remember these notes apply to a real Spectrum and not all the features like the use of microdrives apply to an emulator. Simply down load the zip file, unzip, read the program notes, click on the icon to open the self extracting zip file to install Spec X and you are ready for the ultimate retro experience. In Spec X click file /open and you should get a folder of 3 old Spectrum games, if you want to run the Worthing ATV Program, go to where you put the unzipped folder usually c: unzipped and click on the ATV icon. The Worthing Program should now be running and you should be viewing the start-up screen. Enter your call sign and your Maidenhead Locator and the program is running. The Program Notes in the unzipped files have full instructions on using the soft ware, but try T1 then Enter and you will be viewing a test card screen. If you get fed up with the 10 minute time out of Spec X then send Robin Edwards £10 or download ZX 32 and run the Worthing Program with that instead.


## In Conclusion

The ZX Spectrum was not ideal as testcard generator as the working area of the display did not go any way near to the very edges of the screen. The emulators also do not give a full screen display, but it is fun to use the old Worthing program again. The next step for me will be fitting a VGA graphics card with a PAL video output so the PC can be used on the air. Not a very technical article, just something that some may find fun to do. My thanks to Robin Stephens and Robin Edwards for allowing me to mention their programs and for allowing the download of these from the CQ-TV web site. Please remember The Worthing ATV Program was written nearly 20 years ago and that The Worthing Group and Robin Stephens can not provide any support for this software, you are on your own.

## References

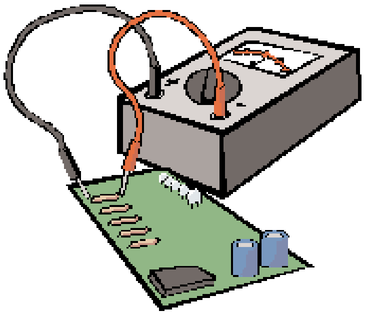
**www.methedrine.demon.co.uk** to download SpecX

**www.cdworld.co.uk/mmcd/seccy.html** to purchase World of Spectrum CD. Since writing this article The World of Spectrum CD is now a 3 CD set and costs £12 from outside the UK. See the web site for details on how to purchase.

**www.geocities.com/SiliconvValley/Bay/9932** to download ZX32.

**www.cq-tv.com** to down load SpecX and Worthing Group Program with notes in one zipped folder. This is the easy way to get and use the Worthing Program, as all the conversion work has been done. Just down load and use and enjoy.

ATVQ



# Sparks from the Bench

**by Ron L. Sparks - AG5RS - Email: atvq@sparkles.com**
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## Light Reading
## A Regular Featured Column!

Recently I was looking at cameras to install for security purposes around my place, and realized that I had forgotten a lot of what I once knew about light and measurements of light. There is a famous saying that goes something like, "Knowledge (or Education) is what is left after you have forgotten everything you learned." So it had not really become knowledge for me. By the way, you will often find that quote attributed, without an attached reference to Einstein, most probably incorrectly. The most likely source is William Feather[1]. But I digress. I went and dug out some old work I did, along with some reference material and began to reinstate the knowledge. After doing that I began thinking about what we generally need to do.

As ATVers we are primarily interested in camera specifications and available lighting. Unfortunately, the measurements for these two items are completely different. It is definitely an "apples and oranges" comparison. I will explain why and what to do about it in a little bit. But first I need to warn you about the specifications themselves. Most of the camera makers have gotten into a "specifications war" much like the power output numbers audio equipment manufacturers put out in the '70s – purposely confusing measurement methods in order to win the battle of the best specs for the least money. Fortunately the American National Standards Institute (ANSI) has published some standards that help a bit, but even now many of the manufacturers numbers should be considered as rough guidelines only.

## From Candela to Lux

One of the first things we have to sort out about light measurements is the amazing array of units. For example, you will find light measured in candelas (and millicandelas), foot-candles, candlepower, lumens, phots, lux, steradians, lamberts, and several others. As if that was not bad enough, when you start trying to convert one to another you will find out that, in some cases, it cannot be done. The reason usually has to do with the nature of light and the ways to measure it. In order to sort things out a bit, lets consider how light can be measured.

First, it can be measured as it is radiated out into space. This is technically called total flux and is analogous to the output power of your transmitter. The second way it can be measured is by the amount of light that strikes a given object. This is called illuminance and is similar to the amount of signal that arrives at your location some distance away from a transmitter. The third way that light is measured is called luminance and is the amount of light that reaches your eye or camera after reflecting off of a surface. Since luminance and illuminance are similar words with very different meanings I like to use the term visibility as a synonym to luminance. I also like to use the term intensity in place of total flux. That gives us three ways to measure light: intensity, illuminance, and visibility.

The units you will come across the most often are millicandela, candlepower, lumens, lux, and foot-candles. The first three are measures of intensity and the last two are measures of illuminance. That is why you cannot just convert the millicandela of an IR LED into the number of lux it produces for the camera. But, you can convert units of type into units of the same type. For example, illuminance units can be converted into other units of illuminance. So since the lux and foot-candle are both illuminance measures you can convert foot-candles to lux by multiplying by 10.24. I have made table 1 to allow you perform this type of conversion. But, since we have candelas and lumens as measurements of our sources we need a method to calculate the illuminance they will create. As hams though, we have an advantage because we are used to power and power calculations. And after all, intensity is just a measure of power – right?

## Intensity

Well, sort of. Light intensity can certainly be measured in watts. Many lasers are specified in milliwatts or watts of output. But most of the time you will find light measured in candlepower or lumens. Why is the usual method more complicated you might wonder? It has to do with the spectrum of light generated. Many light sources are wideband, just as an ATV signal has its power distributed across a wide spectrum. You cannot easily relate the power of an ATV signal to a pure carrier's power. That is why we generally specify a complex signal in terms of PEP or RMS power. That is exactly why light sources are not usually rated in watts of <u>output</u>. Be careful with that term. When you think about transmitters you automatically think of <u>Output</u> power. When you think about a 60-watt bulb, though, you are thinking of <u>Input</u> power. If you were to analyze that bulb you would find it is less than 10% efficient so the output power is below 6 watts.

So how can you get from watts to lumens? It is actually pretty easy. One lumen is 1.47 milliwatts of power if the light is all on a single frequency (color). That works out to be 680 lumens per watt if you do the division. So if we guess our 60-watt bulb is 10% efficient you would get:

**6 watts X 680 lumens/watt = 4080 lumens**

Hmm, that gives us a problem. The box the 60-watt bulb came in says it puts out 870 lumens. So what is wrong? Remember I said that the conversion is for *a single frequency*. If you consider that the bulb is spreading its power over a range of a few hundred terrahertz you can see the problem. I'll spare you the math, but a good number to use for a broad band light source like an incandescent, halogen, or even fluorescent is about 179 lumens/watt. If we use that then our number becomes:

**6 watts X 179 lumens/watt = 1074 lumens**

Which is a lot closer to the number on the box. If you use the manufacturers rating and calculate the actual efficiency it comes out to be 8.1% instead of the 10% we guessed. That means we now have a good approximation for broad band sources, too.

My recommendation is that you use 680 lumens/watt for narrow band sources like lasers and LEDs. For white (that is, broad band) lights I recommend you use 179 lumens/watt. Just remember, the more the light is "packed" into a narrow frequency band (that is, color) the more efficient the source will be in lumens/watt. Unless you have some very specific problems, these typical numbers should work pretty well.

Another way to look at the light source is by its overall efficiency and that is a good way to compare sources. Just take the lumens of output and divide it by the watts of input it consumes. The higher the number, the more efficient the source is and therefore it will cost less to operate for a given output requirement. As an example, the 60-watt incandescent has an overall efficiency of 14.5 lumens/watt (870 lumens  60 watts). But my 70-watt High Pressure Sodium (HPS) yard light has an overall efficiency of 76.8 lumens/watt (6300 lumens  82 watts). This is an improvement of over five times, or 7.3 dB for us hams. You may wonder about the 82-watt number. Remember we want overall efficiency and since an HPS fixture has a ballast, this one looses about 12 watts there.

## Illuminance

Now we have one side of the system defined – the transmitter (light source). In order to help with the purchase of that camera we need the other side – the receiver. This is where things start to get a bit muddled. Illuminance is how much light strikes the object you want to, well, illuminate. Luminance, which we agreed to call visibility, is how much of that light gets reflected and finds its way back into your eye or camera. So, technically we should be looking at the visibility measurements when we specify our cameras. That would allow us to compare the efficiencies of cameras very effectively. But there are a lot of variables that would be introduced to do that, like path loss, the gain of the lens, the size of the object being illuminated, its color, etc.

When you see a specification that says a camera will work in 3 lux, that number is nearly meaningless. Is it 3 lux on an object 10 feet or 25 feet away? Is it 3 lux on a gray object or a green one or a pattern of some sort? Is it 3 lux of white light or monochromatic light? See, there is a lot missing in that 3 lux number. If one manufacturer uses white incandescent light on a gray 1 $ft^2$ target 1 ft away and their competitor uses a monochromatic source on a same color grating 5 ft away there is no way to compare the cameras using just the lux rating.

One way to make some sense of this is to back up and look at what a lux actually is. It turns out that if you had a light source that was a perfect point with a power of one lumen and you put it inside a sphere that was exactly two feet across (one foot radius) then you could measure the light falling on the inside of the sphere. If you dig up your high school geometry book you will find that a sphere with a radius of one foot has a surface area of $4 \cdot\cdot r^2$ =12.56 square feet. If you have worked with light measures much at all you will recognize that number. It is the conversion from candlepower to lumens. That is because the lumen was derived from the older candlepower measurement.

Here is where illuminance gets a little tricky. If you imagine that candle (or 12.56 lumen source) inside a one foot radius sphere the amount of light that falls on one square foot is said to be a certain number of lux. But if you make the sphere 10 foot radius, the same number of photons are covering a surface 100 times larger (radius squared, remember). So the number of lux will be $1/100^{th}$ what it was in the smaller sphere. This is probably a good place to re-mention that one foot-candle is equal to 10.24 lux. But for many illumination designs you will see that simplified to just 10.

I will not bore you with the engineering, but here is a good rule of thumb. If the length and width of the source is less than one fourth the distance to the object being illuminated you can just use the square of the distance to estimate how much the illuminance changes. For example, if you measure the illumination on the ground 10 feet from your yard light to be 15 foot-candles (150 lux) then at 100 feet it would be:

$$15 \text{ X } (10^2 \quad 100^2) = 0.0015 \text{ ft-cd} = 0.015 \text{ lux}$$

Which is pretty dim. That is just below moonlight and in the range of starlight. If you want to look at typical illumination levels you should go to the library and check out a book by the Illumination Engineering Society (IES). They have the same info on their web site but you have to be a member to access the good stuff. I have summarized some typical levels you might expect in table 2.

## Cameras

Now that we know what a lux is let's consider that camera. If it says it can work at 3 lux then you can be sure that the darkest area of the scene you are trying to look at better be brighter than 3 lux or you will not see it. A really handy item to have is called a "50% Gray Card" that can be obtained from good photographic suppliers pretty inexpensively. This is the standard that most photographic light meters are calibrated to. In theory it is a perfectly diffuse object with exactly 50% reflectance to all colors of light.

What this card allows you to do is “work backwards” to your various cameras. For example, get your very best camera and set it to focus on the gray card. Then adjust the light on the card until the camera just begins to loose quality. At that point, take an inexpensive photographic light meter and measure the light reflected from the card and note the meter’s reading. That reading will become your basis for comparison of all your other cameras. You might not know exactly how many lamberts it represents (yes, a lambert is the unit for the third type of measurement – visibility or technically luminance), but you will be able to get relative comparisons for all your cameras. Also, you will be able to use the meter to measure the gray card in a given situation and know if your camera will be able to handle it.

Here I am going to go way, way, out on a limb and give you some general “go-by” numbers for your experiments. I have found that most of my cameras need a surface with about 20% more than their specified lux number to be able to tell it from a pure black. I have also found that color cameras loose their color resolution and quality well above their rated lux number. For example, even on my most sensitive color camera the colors begin to shift dramatically and fade around 10 lux. Since that is a subjective opinion, I would certainly like to hear from any of you with different experience.

Another thing that is a bit uncertain is the point where the resolution begins to drop. Even on a B&W camera I rarely (never?) see the specified lines of resolution at the minimum lux number. What this means to the average ATVer depends on your usage. If all you want do is to see objects in the dark, then an IR illuminator and B&W camera will probably work just fine out to about 10 ft if the area needed is small. So the advertised specifications may be adequate. On the other hand, if you want a P5, good resolution, high quality color picture of you in your shack, then do not even think about light levels near the camera’s rating. You will be quite surprised how much light is needed.

I measured the light in several rooms of my house with just the overhead light (two 60 watt bulbs) and found it to be somewhere between 2 and 5 ft-cd (20-50 lux) on most objects. I was not happy with the quality and resolution of the picture from my camcorder camera (a major name brand) until I got brought in extra lights and got the levels up to 10 ft-cd (100 lux) or so, even though it was rated for 3 lux operation.

Basically, you will just need to do some experimentation to find the best match between lighting, camera, and purpose. I am certainly interested in hearing the measurements you make using your cameras and gray cards.

## LEDs

A word is in order here about LEDs. While they are very efficient light sources and are getting quite bright, they can be difficult to use as light sources for cameras. That is because of the beam width. Remember that I said that illuminance was the number of lumens (or candela) spread over a given area. So to get the foot-candles (lumens/ft$^2$) for a white LED we need to check the beam width specifications. I found several with a 20 beam width and a brightness of 2000 mcd. So let’s look at how well that would illuminate an ATV operator sitting in a chair

**Lighting Units and Conversions**
Table 1

| | | | | |
|---|---|---|---|---|
| **Total Flux (intensity)** | | | | |
| 1 | Watt | ± | 680.3 | Lumen (monochromatic 550nM) |
| 1 | Watt | ± | 179 | Lumen (white) |
| 1 | Watt | ± | 100 | Lumen (real candle) |
| 1 | Lumen | = | 0.07958 | Candle |
| 1 | Candle | = | 1 | Candela |
| 1 | Candle | = | 1 | Candlepower |
| 1 | Candle | = | 1 | Candlepower (Spherical) |
| 1 | Candle | = | 12.5664 | Lumen |
| 1 | Candle | = | 0.96 | Candle (English) |
| **Illuminance** | | | | |
| 1 | Lux | = | 0.0929 | Foot-Candle |
| 1 | Foot-Candle | = | 10.7639 | Lux |
| 1 | Foot-Candle | = | 1.3566 | watt-seconds |
| 1 | Lux | = | 1 | Lumen/m$^2$ |
| 1 | Lux | = | 0.0001 | Phot |
| 1 | Lumen/ft$^2$ | = | 1 | Foot-Candle |
| 1 | Lumen/ft$^2$ | = | 1 | Light Flux Density Unit |
| 1 | Lumen/m$^2$ | = | 1 | Lux |
| **Luminance (visibility)** | | | | |
| 1 | Lambert | = | 0.3183 | Candle/cm$^2$ |
| 1 | Lambert | = | 2.0536 | Candle/in$^2$ |
| 1 | Lambert | = | 929.0304 | Foot-Lambert |
| 1 | Ft$^2$ of perfectly diffuse surface lit by 1 Foot-candle | = | 1 | Foot-Lambert |
| 1 | Lumen/ft$^2$ | = | 1.0763 | milliLambert |
| 1 | Lumen/cm$^2$ | = | 1 | Lambert |
| 1 | Lumen/cm$^2$ | = | 1 | Phot |

**Typical Values & Other Useful Measures**
Table 2

| | | | |
|---|---|---|---|
| Light Adapted Human Eye | ± | 1 | milliLambert |
| Dark Adapted Human Eye | ± | 0.00001 | milliLambert |
| Human Peak Blue Response | ± | 445 | nM |
| Human Peak Green Response | ± | 555 | nM |
| Human Peak Red Response | | 600 | nM |
| HeNe Laser Frequency (most common) | = | 632.8 | nM |
| Recommended Workbench (fine work) | ± | 1200 | Lux |
| Recommended Workbench (regular) | ± | 500 | Lux |
| Typical Full Sun | ± | 100,000 | Lux |
| Typical Cloudy Day | ± | 10,000 | Lux |
| Typical Office | ± | 100-1000 | Lux |
| Typical Sports Field | ± | 200-1000 | Lux |
| Typical Home Living Area | ± | 30-100 | Lux |
| Typical Roadway Lighting | ± | 5-15 | Lux |
| Typical Full Moon | ± | 0.25-0.01 | Lux |

three feet away and holding our 50% gray card.

First we need to determine how much area a 20 beam covers at 3 feet:

$$3 \text{ ft} \;\; 12 \text{ in/ft} \;\; \sin(20°) = 12 \text{ inches in diameter}$$

Well, that is a pretty tight spot. Let's continue anyway. Next we need to calculate the area in that spot:

$$\cdot r^2 = (0.5 \text{ ft})^2 \text{ X } 3.1416 = 0.785 \text{ ft}^2$$

Now that we have the intensity and the area we can calculate the illuminance:

$$(2000 \text{ mcd} \;\; 0.001 \text{ cd/mcd} \;\; 12.57 \text{ lumen/cd}) \;\; 0.785 \text{ ft}^2 = 32 \text{ foot-candles} = 327 \text{ lux}$$

Wow, that is most likely plenty bright for most cameras and for about 1/800$^{th}$ the power that would be required for an incandescent bulb. BUT, it only covers about 0.8 square foot where the incandescent bulb would be covering 144 times more area. That tells us that some form of beam spreader will usually be needed with LEDs unless you can use several and point them to create a wider beam.

## Summary

The best advice I can give you is to experiment with controlled situations. If you get your gray card and calibrate a meter for your camera, then you should be ready to know what to expect when you are out "on the road". If I get enough good numbers from all of you I will publish them in a future column and try to discuss what they mean and why they happened the way they did.

As for me, I think I am leaning toward a dual system. Color for daylight and IR illuminated for low light and night. Now I just need to calculate the path loss on the 2.4 GHz wireless transmitter and see if I can find a way to keep it Part 15 and still receive it at the house 700 ft away.

Until next time, keep your pictures bright and your transmissions P5.

**References**


1. William Feather (1889–1981), "An education isn't how much you have committed to memory, or even how much you know. It's being able to differentiate between what you do know and what you don't. It's knowing where to go to find out what you need to know; and it's knowing how to use the information you get.", *Quotable Quotes on Education,* p. 17 (1968). Unverified. This is possibly the source of the quote often abbreviated and attributed to Einstein. Just about any quote that people spread around without knowing where it came from gets attributed to Lincoln, Edison, or Einstein. So, if anyone knows the paper or speech that proves the knowledge/education quote came from Einstein, please let me know.
2. "Lighting Handbook", Illumination Engineering Society of North America (IESNA)
3. Design Guides, Various, (IESNA)
4. "You Light up my…Screen", Ron Sparks, CQ VHF magazine, April 2000
5. [RTF bookmark start: ]_Hlt68974828[RTF bookmark end: ]_Hlt68974828


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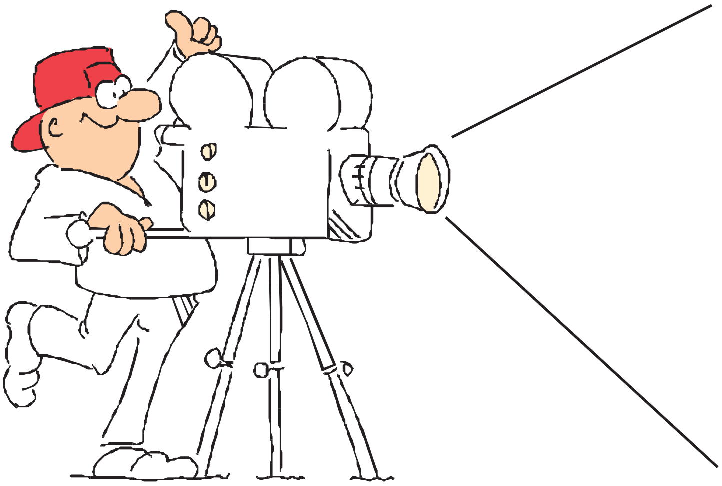

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# Amateur Television Contest 2004

Contest period 00:00z 06/01/04 to 00:00z 09/01/04

Contest goal: To raise activity and promote *long haul* contacts on ATV.

Participants must hold at least a Technician class license and be within the boundaries of North America, Alaska or Hawaii.

In case of multiple Ham occupants, they may share equipment during the contest so long as the intent is not merely to manufacture points. All occupants who enter must submit their own log.

**Schedules:** The use of schedules is allowed, and can be made by any means available. The use of 144.340 mhz national ATV calling frequency is also allowed and encouraged.

REPEATER CONTACTS DO NOT COUNT. Distance calculations will be between both stations in the QSO with no relay allowed.

**Exchange:** Callsign with at least P-1 video on any amateur band 70cm and above.

**MOBILE** or **PORTABLE** stations must exchange their location at the time of contact as determined by portable GPS or other verifiable means.

**VIEWER:** Station does not have to exchange any video but must be a licensed amateur and confirm at least a P-1 reception report to the transmitting station via 2 meters or another amateur band.

**CLASSES:** There will be 4 classes for participants:

**HOME:** Primary location of residence with Fixed Antenna structure. Minimum distance for repeat contacts (75 Miles)

**PORTABLE:** Station can be set up just for the contest and may not operate from any other location during the contest period. Minimum distance for repeat contacts (50 Miles)

**MOBILE:** Station can operate stopped or while moving but all antennas must be affixed to the mobile unit and capable of transmit while in motion. Minimum distance for repeat contacts (25 Miles)

**VIEWER:** Station must be able to receive video at P-1 signal level and relay report to the transmitting station. Minimum distance for repeat contacts with this class is determined by the transmitting stations type or class.

**Scoring System:** Each valid contact will be awarded points for the mileage between the two stations on an ever-increasing difficulty per frequency basis as follows:

70cm = 2 points per mile

33cm = 4 points per mile

23cm = 6 points per mile

13cm and above gets 10 points per mile!

A station can be worked for points only once unless they are a minimum distance apart as specified by the class of entry. (See CLASSES) and then they may be worked once in a calendar month through the contest period.

The distance between stations will be calculated by the Maidenhead Grid and sub grid identifier coordinates listed on QRZ.com and rounded down to the nearest mile. Every effort should be made by entrants to verify or update their information before the contest starts. If you do not have Internet to look up a stations coordinates please ask the other station, if they do not know then leave the mileage column blank and it will be determined by the verifier. No changes can be made to coordinates once the contest starts unless you move.

Distance will be calculated with the (Bearing and Distance) DOS program by W9IP that is used by the ARRL for distance records.

**LOG's:** All logs must be in a standard format as specified below:

**STATION WORKED  RPT REC  RPT SENT  UTC  DATE  FREQUENCY  GRID SQ  DISTANCE  POINTS**

Your log information should also include your Name, Address, your Maidenhead Grid and sub grid identifier coordinates, and a list of equipment used. Sample Log is below and a full page Log sheets will be available on www.hampubs.com .

Logs can be submitted by email or regular mail and must be received by September 15th to be eligible for contest Awards. Send the logs to:

**ATVQ Contest - 5931 Alma Dr. - Rockford, IL 61108** - or to: **ATVQ@hampubs.com**

**AWARDS:**

All Scores will be published in ATVQ and certificates will be awarded for the top three scores in each class. The highest overall score of the contest (The one who covers the most points on ATV) will receive the OVERALL WINNER PLAQUE ATVQ

| CALL | | | GRID SQ. | | | CLASS | | |
|---|---|---|---|---|---|---|---|---|
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| NUMBER OF DIFFERENT STATES WORKED | | | | | | | | |

# Driving Video Lines

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When does a trace or a wire become a transmission line? Bandwidth, characteristic impedance, ESD, and shoot-through considerations for selecting the proper video driver, receiver, mux-amp, or buffer.

Engineers are aware they must match impedances to avoid reflections when driving transmission lines. This is especially true in video, with its wide range of component frequencies. While most applications span a few octaves, video covers six or more.

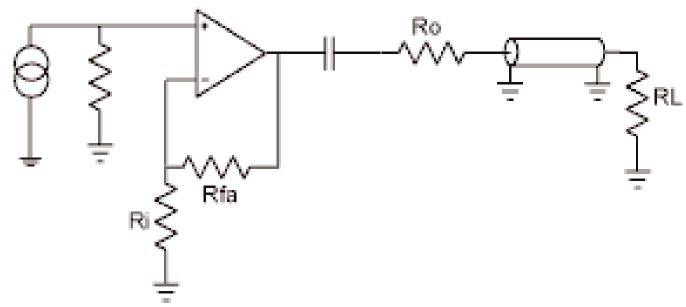
Only dissipative elements (resistors) can be relied on for matching1 over such wide bandwidths. The use of resistors creates a loss. The driver must compensate with added gain. That's why most video drivers have a fixed gain of two2, though some are settable. This allows long lines to be equalized, restoring their frequency response to the required bandwidth for the application.

It is obvious that coaxial and differential-pair cables are transmission lines. But when does a trace or a wire become a transmission line, and is this a problem in video design?

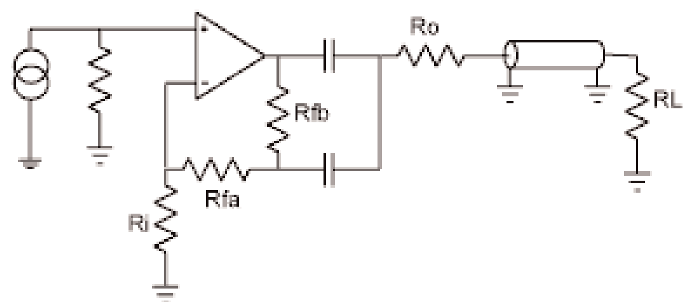
## Bandwidth

The first information needed when designing or choosing a video driver is the bandwidth. Microscopically, video is a bitstream, and the high-frequency end depends on the rise/fall time of the waveform. To reproduce the waveform with satisfactory fidelity, the upper -3db point should be between 0.35 to 0.50 over the rise/fall time3 of the video signal, thus putting the high end of the video bandpass in the tens or hundreds of MHz. Macroscopically, video is an image, and to reproduce it we have to pass the rate at which it was sampled, or the frame rate. This sets the low end around 2.5 to 5Hz. AC coupling would require large capacitors, which is why most applications are DC coupled. It also means that the driver must sink and source current to the load, which is returned by the supply. Because of that, even DC-coupled drivers require large supply-bypass capacitors close by to avoid including the power supply trace in their design.

The size of the AC coupling caps can be reduced by "bootstrapping" the load, as shown in Figure 1. The gain is boosted at lower frequency by adding Rfb, which is shunted out at high frequency by the second coupling capacitor. This reduces the value of Cc, but you'll need two of them.




Video Driver with Large Coupling Caps




The same Driver with Smaller Coupling Caps

**Figure 1. A method to reduce the size of the coupling capacitors by bootstrapping the load**

The next question may sound odd, but how long is the line? A transmission-line's bandwidth depends on its length. For example, at 10MHz, 100ft of RG-59A has 1.1db IL (insertion loss), 200ft has 2.2db IL, and 300ft has 3.3db4. Depending on the length, NTSC or PAL video experiences little loss, but HDTV or SXGA video would be affected. To correct for this, the line is "equalized" to restore overall response to the necessary application bandwidth. The equalizer has an inverse-frequency characteristic, compared to that of the transmission line, to create a flat response at the end of the line. A simple equalizer can be built into the driver (Figure 2), as long as the equalization (blue line) is inside the GBW of the driver (red line). This requires more gain-bandwidth in the driver, but for fixed-length lines it's less expensive than a line receiver. To allow this, some drivers have settable, rather than fixed gain.

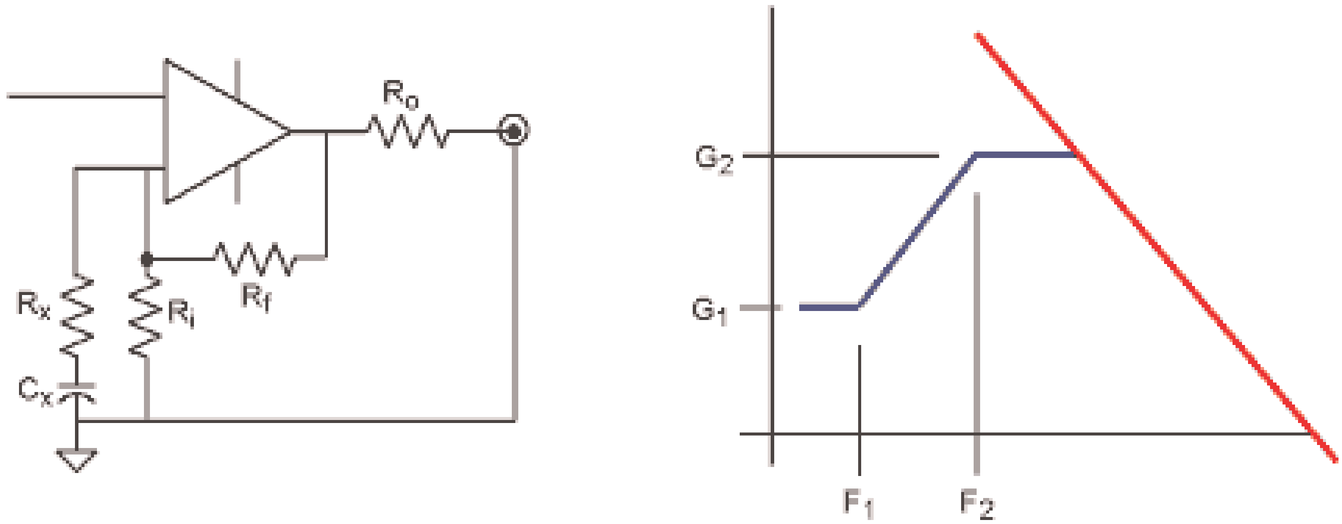



**Figure 2. A simple R-C equalizer (pre-emphasis) is used to compensate for loss between F1 and F2.**

### Characteristic Impedance

Transmission lines have a characteristic impedance (Zo) with which they should be driven and terminated; and, in video, the most popular is the 75 coaxial cable. This give the 150 "back terminated" unit load the driver sees due to the series 75 source resistor, (Ro in Figure 2) and the 75 line. But what about "other lines"? PCB traces and wires: are they lines?

The Long and the Short of It

To determine if a trace or wire is a transmission line, we need to know its electrical length. That's given in terms of the rise/fall time of the video (tr) by5;

L = tr/(t/l)

Where, t/l is the delay per unit length (see Table 1). As the length approaches about 1/6*L it starts to look like a "line". Before that, it doesn't have a characteristic impedance, only a reactance6.

To get a scale of things, HDTV signals exhibit a rise-time of 20nsec, so a trace has to be about 2ft long to be a transmission line. Rise/fall times would have to approach 1-2nsec before PCB traces become transmission lines. Mainly, it's reactance that causes problems, narrow traces are series inductors, wide ones are shunt capacitors. Drivers are more tolerant of shunt capacitance than of series inductance.

Things to remember are:

an inch of #20AWG wire has about 20nH of inductance

an inch of 0.030 trace has 10nH

and a sq inch of FR-4 has about 5pF of capacitance. inductance scales by length, capacitance by area.

**Table 1. Typical Delay Times for Various Types of Transmission Lines**

| Transmission Line/Dielectric | Delay(picosec/in.) |
|---|---|
| Wire in Air (Vacuum) | 85 |
| Coax (RG-59A, 75, 66% Propagation) | 128 |
| Coax (RG-58A, 50, 66% Propagation) | 128 |
| Coax (RG-11A, 75, 55% Propagation) | 154 |
| PC Board, Inside Trace (FR-4) | 140 |
| PC Board, Outside Trace (FR-4) | 180 |

Another potential problem on PCB is the "via" that connects traces between layers. At high-frequency, a Pi filter7 is formed which can "ring" on fast transitions. This is often seen in video-reconstruction-filter applications that originate from a narrow (high Zo) trace in a digital portion of a board. These signals have faster rise/fall times than video, usually set by the logic family used in the DAC. In such cases, it's best to keep the line short and terminate it as best you can. Then put a buffer or driver after the via.

Besides the length, a transmission line must be homogenous. This means it must be over a continuous return path. Even though a trace isn't a transmission line, failing to put a continuous ground under it can have subtle side effects. The first is that you can't get rid of the ringing usually followed by coax being soldered to the board. The second is cross-talk over and above what you expected, followed by more coax.

Although most PCB traces aren't transmission lines, they act as if they were. In this case, it's the return current. Don't route video lines over split planes or large gaps. It change the reactance causing ringing, and mixing ground currents causing cross-talk.

## ESD and Shoot Thru

This isn't a video problem, but it does effect video drivers that are used to connect to an external load. To protect them, the output has shunt diodes to the supply and to ground to protect the driver from ESD originating outside the chassis.

New set-top boxes, video games, VCRs, DVDs and even TV sets have isolated (2-wire) chassis today, causing a potential problem called "shoot thru". Here the mains bypass capacitors called "Y Caps" charge and discharge the chassis to peak AC line potential. The chassis is also the video ground. As long as the driver is connected to equipment on that same AC line, nothing much happens, except to the well-grounded and unwary. Cable and satellite receivers have to be connected to earth-ground for operation and safety reasons. The most common connector for commercial video, the RCA jack, will likely connect the signal pin first. To avoid damaging the driver, there have to be shunt diodes at the input as well as the output.

## Choosing A Driver, Receiver, or Buffer

Tables 2 and 3 show large-signal bandwidth (2Vp-p), slew rate, differential gain and phase, and supply voltage for Maxim's most popular video drivers, buffers, and receivers with single-ended and differential outputs.

A special subset of the video driver is the video-distribution amplifier (see Table 4). Built to drive multiple loads, they offer higher isolation, selectable outputs, fixed or settable gain and are often used in professional equipment.

Another subset of the video driver is the video mux-amp (see Table 5). Mux-amps combine a video multiplexer and a video line driver for routing video signals.

**Table 2. Single-Ended Video Line Drivers and Buffers**

| P/N | No. of Amps | Operating Voltage (V) | -3dB LSBW (MHz) | Slew Rate (V/µs) | DP/DG (°/%) | Notes |
|---|---|---|---|---|---|---|
| MAX4450/1 | 1 / 2 | +5, ±5 | 175 | 485 | 0.08/0.02 | SC70/SOT23 Packages |
| MAX4350/1 | 1 / 2 | ±5 | 175 | 485 | 0.08/0.02 | SC70/SOT23 Packages |
| MAX4380-4 | 1 / 2 / 3 / 4 | +5, ±5 | 175 | 485 | 0.08/0.02 | SC70/SOT23 Packages, Disable Avaiable |
| MAX4389-96 | 1 / 2 / 3 / 4 | +5, ±5 | 127 | 200 | 0.015/0.015 | SC70/SOT23 Packages, Disable Avaiable |
| MAX4012/16/18/20 | 1 / 2 / 3 / 4 | +3.15 to +11 | 140 | 600 | 0.02/0.02 | Disable Avaiable |
| MAX4212/13/16/18/20 | 1 / 2 / 3 / 4 | +3.15 to +11 | 180 | 600 | 0.02/0.02 | Disable Avaiable |
| MAX4214/15/17/19/22 | 1 / 2 / 3 / 4 | +3.15 to +11 | 140 | 600 | 0.02/0.04 | Gain of 2 Buffer, Disable Avaiable |
| MAX4214/15/17/19/22 | 1 / 2 / 3 / 4 | +3.15 to +11 | 220 | 600 | 0.02/0.04 | Gain of 2 Buffer, Disable Avaiable |
| MAX477 | 1 | ±5 | 200 | 1100 | 0.01/0.01 | 130 MHz 0.1 dB Gain Flatness |

**Table 3. Differential Video Line Drivers and Receivers**

| P/N | Driver/ Receiver | Operating Voltage (V) | -3dB LSBW (MHz) | Slew Rate (V/µs) | DP/DG (°/%) | Notes |
|---|---|---|---|---|---|---|
| MAX435 | Driver | ±5 | 275 | 800 | Not Specified | 300uV Input Offset Voltage |
| MAX4142 | Driver | ±5 | 180 | 1400 | 0.01/0.01 | Fixed Gain of 2V/V |
| MAX4147 | Driver | ±5 | 250 | 2000 | 0.03/0.008 | Fixed Gain of 2V/V |
| MAX4447/8/9 | Driver | ±5 | 405 | 6500 | 0.01/0.02 | Single-Ended Input |
| MAX436 | Receiver | ±5 | 275 | 800 | Not Specified | 300uV Input Offset Voltage |
| MAX4144/5/6 | Receiver | ±5 | 110 | 1000 | 0.03/0.03 | Shutdown Mode |
| MAX4444/5 | Receiver | ±5 | 500 | 5000 | 0.05/0.07 | Shutdown Mode |

**Table 4. Distribution Amplifiers**

| P/N | No of Outputs | Operating Voltage (V) | -3dB LSBW (MHz) | Slew Rate (V/µs) | DP/DG (°/%) | Notes |
|---|---|---|---|---|---|---|
| MAX4135/6 | 6 | ±5 | 185 | 1000 | 0.1/0.1 | 0.1dB Gain Flatness to 40MHz |
| MAX4137/8 | 4 | ±5 | 185 | 1000 | 0.1/0.1 | 0.1dB Gain Flatness to 40MHz |

**Table 5. Video Mux-Amps**

| P/N | Inputs: Outputs | Operating Voltage (V) | -3dB LSBW (MHz) | Slew Rate (V/µs) | DP/DG (°/%) | Notes |
|---|---|---|---|---|---|---|
| MAX4310 | 2:1 | +5, ±5 | 110 | 460 | 0.06/0.08 | Unity Gain Stable |
| MAX4311 | 4:1 | +5, ±5 | 100 | 430 | 0.06/0.08 | Unity Gain Stable |
| MAX4312 | 8:1 | +5, ±5 | 80 | 345 | 0.06/0.08 | Unity Gain Stable |
| MAX4313 | 2:1 | +5, ±5 | 40 | 540 | 0.09/0.03 | Fixed Gain of 2 |
| MAX4314 | 4:1 | +5, ±5 | 90 | 430 | 0.09/0.03 | Fixed Gain of 2 |
| MAX4315 | 8:1 | +5, ±5 | 70 | 310 | 0.09/0.03 | Fixed Gain of 2 |

1 Wideband Circuit Design, Carlin, ISBN0-8493-7897-4

2 Although the terms are often interchanged, video buffers as opposed to video line drivers, usually have a gain of +1V/V.

3 High Speed Digital Design, Johnson and Graham, ISBN 0-13-395724-1

4 Transmission Line Design Handbook , Waddell, ISBN 0-89006-436-9

5 High Speed Digital Design, Johnson and Graham, ISBN 0-13-395724-1

6 Wideband Circuit Design , Carlin, ISBN0-8493-7897-4

7 Transmission Line Design Handbook , Waddell, ISBN 0-89006-436-9

# ATV Three Pole Bandpass Filters

by Mike Collis - WA6SVT Email: WA6SVT@aol.com
POB 1594
Crestline, CA 92325

This issue of the "Q" we will cover small tunable three pole bandpass filters for 430 MHz, 915 MHz and 1250 MHz bands. These filters are used for receiver downconverters and transmitter upconverters. The loss is in the 2 dB range with an approximate three percent (of operating frequency) passband.

The filters use readily available Johansen 0.8-10 pf piston capacitors and hobby brass. The use of these filters are best suited after the first preamp to overcome the 2 db loss in receivers and work well between an existing downconverter and outboard LNA to strip out the image frequency and out of band signals. In transmitter upconverters they are used after the mixer to remove the local oscillator signal and image frequency before amplification. Most of ATN's ATV repeaters use these filters for our modification of CATV modulators to produce 1250 and 915 MHz band signals.

The filters featured in this article where designed and drawings by silent key Sam, K6VLM. He was a long time ATV pioneer and my ATV mentor from the time I started in ATV. Sam home brewed all of his state of the art ATV equipment and antennas.

## Fabrication:

The all four sides of the filter are made with .032" x .5" brass hobby strap prepared as illustrated in Sam's drawing before being bent into a square frame. The holes for the tuning caps are ¼ inch diameter so take care not to use to much force when drilling so the strap will not get bent up if the bit tries to grab the strap. The other holes are smaller and should not have any problem. Sam designed the filter to accept miniature Teflon coax directly but you can substitute SMA connectors. You may need to add a jumper from the SMA connector pin to the resonator rod (some SMA connectors are long enough to reach the rod) and drilling a (coax hole is .135") larger hole to accommodate the connector.

The bottom lid can be made longer than the frame to accommodate mounting the filter. Solder the bottom to the frame and solder the end of the frame together. You can make the top lid with flaps bent at 90 degrees and just very slightly smaller size than the frame to make a tight fit for future access to the inside of the filter or you can make a lid the size of the outside dimensions of the frame and solder it in place.

## Tuning the filter:

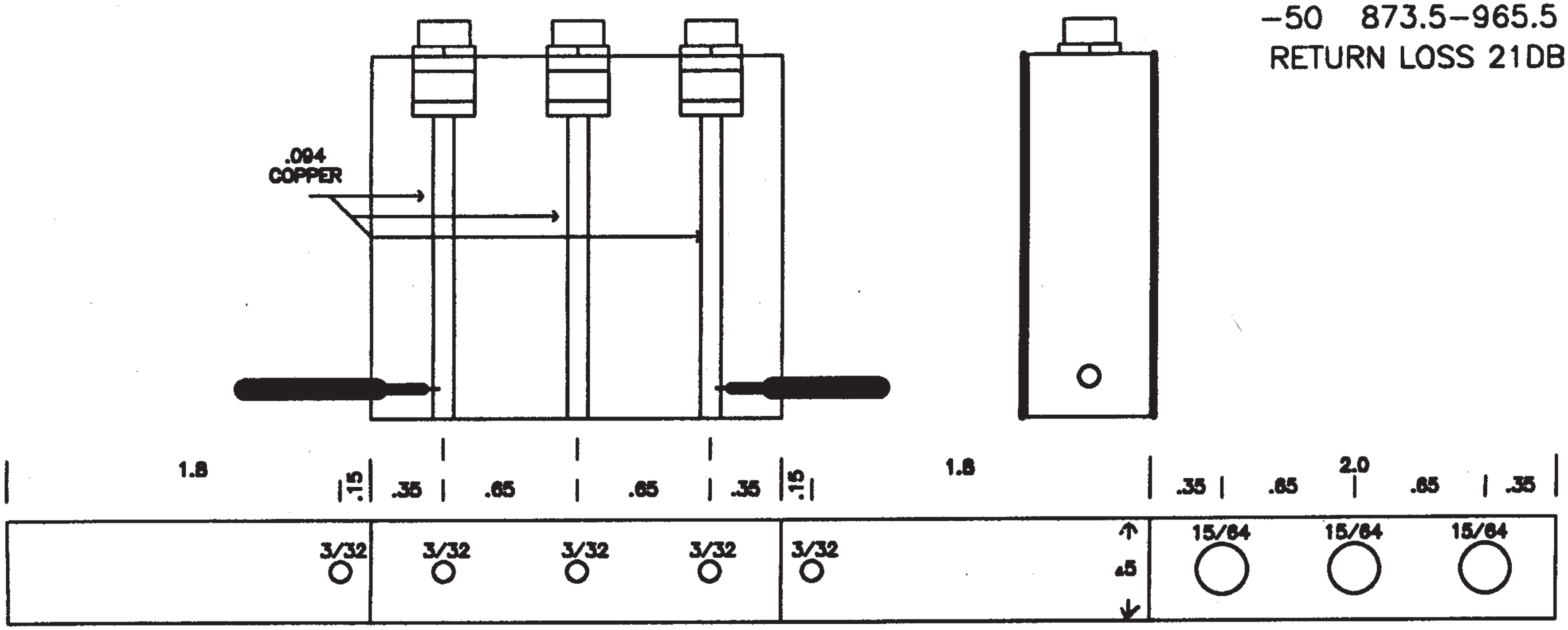
Set the Johansen caps near minimum capacity and connect a signal generator and spectrum analyzer peak the filter in the center of the ATV channel you want to use in the band. If the analyzer has a built in tracking generator then span it to about 50 MHz to see the passband and tune the filter for a flat response.

If you have an analyzer without a tracking generator, I have used an ATV AM(not a VSB) or FM exciter attenuated down to a few milliwatts with subcarrier activated and tuned the filter for a peak video carrier and equal level on upper and lower subcarrier.

I did not provide a picture of the filter due to all my filters are at ATN's repeater sites. ATVQ

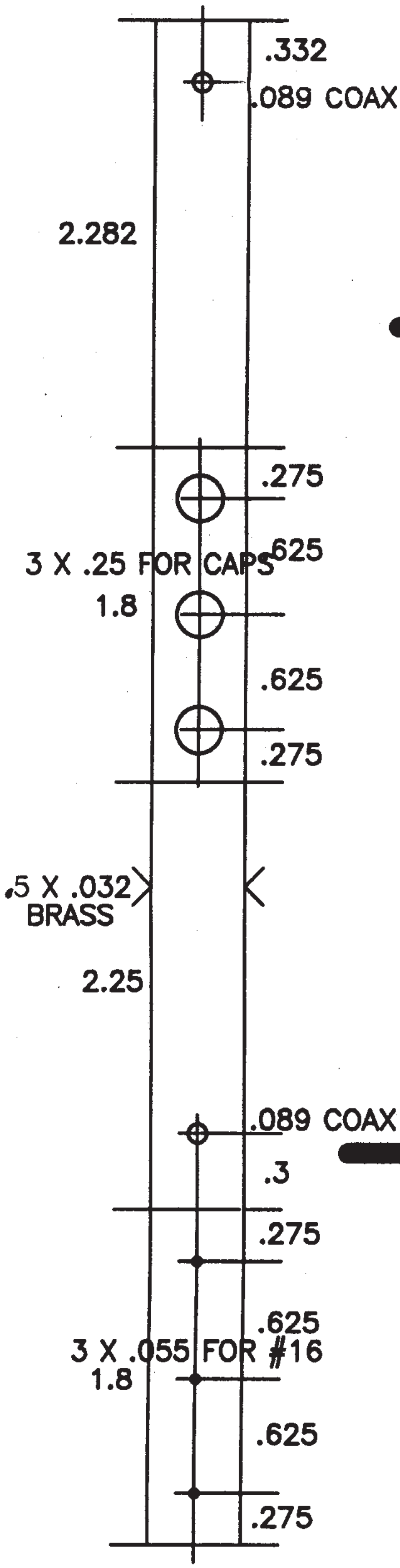
900MC FILTER 3DB BW 12.1MC
BOX .5 X .032 BRASS SIDES 7.6 LONG
COVER .032 BRASS ELEMENTS 3/32 COPPER
VARIABLE CAPS JOHANSEN .8–10 PF

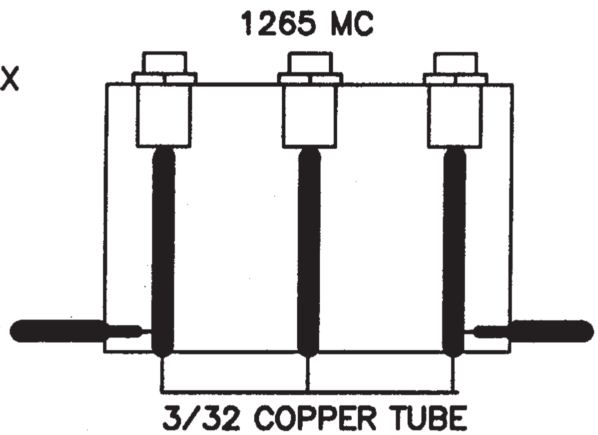
INSERTION LOSS 2.1DB
−1DB 914.8–926.6
−3 913.3–928.3
−24 900.5–940.9
−50 873.5–965.5
RETURN LOSS 21DB

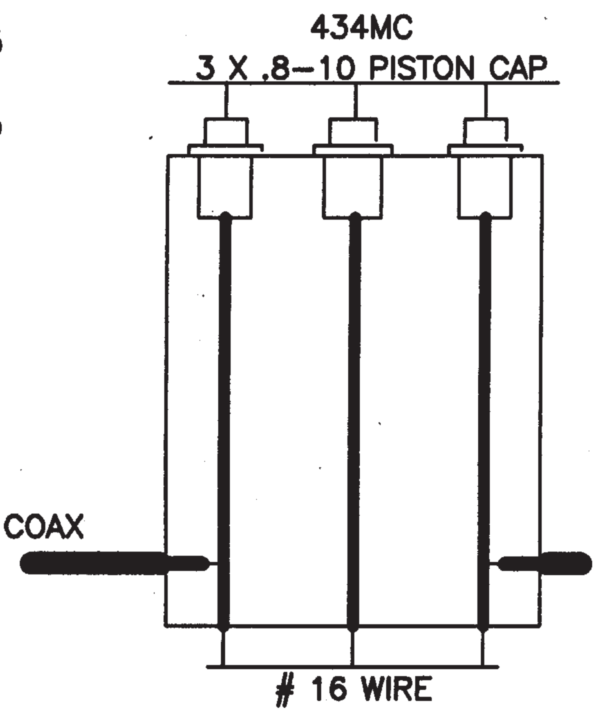



The rods are soldered to the base. The center of the coax is connected to the rod at .15”, ie: the same distance up that the hole for the coax is.

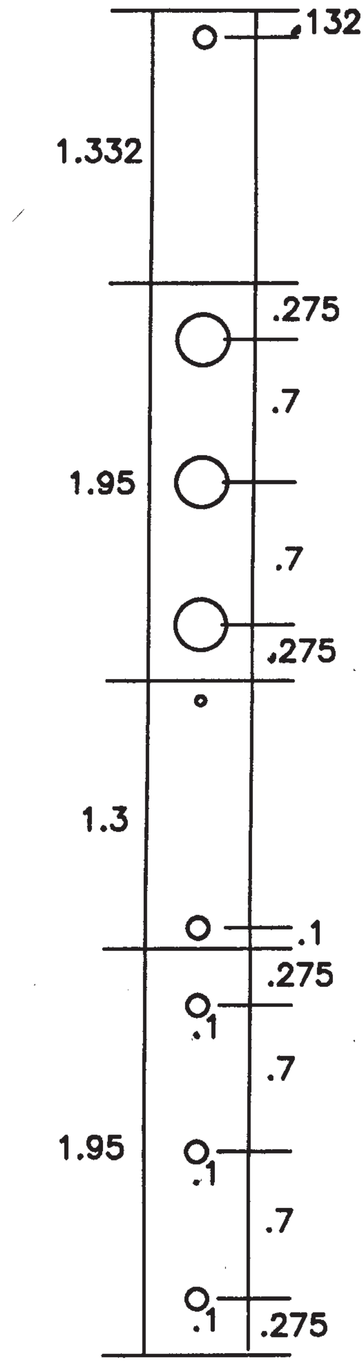
**Sides for 434 MHz Filter**




**Sides for 1265 MHz Filter**



## NEW ATN CHAPTERS

ATN-IL Gene Harlan, WB9MMM, of ATVQ has started a new chapter last summer in Rockford, IL. They built a repeater, W9ATN, located in Rockford. The output is 421.25 MHz horizontal with inputs on 434 MHz and a FM input on 1253 MHz. At the Dayton Hamfest, Mike, WA6SVT, presented Gene with a 5 watt VSB transmitter on 421.25 MHz to help the new chapter get the repeater on the air. Great work guys!

Two other areas have an interest in forming ATN chapters. Bill Brown, WB8ELK, in Huntsville, AL and Ralph Fowler, N4NEQ, in Atlanta, GA. We hope you both get your chapters formed soon!

**ATV at DAYTON:**
Many ATN members were there this year from almost all of our chapters. Don our webmaster was taking photos for the website. Mike, WA6SVT, gave ATV presentations at both the Friday night and the Saturday ATV forum. We met with ATVers from Europe and other ATV groups stateside. It was great! We hope to have a bigger ATN presence this year!

**ATN WEBSITE:**
Don, KE6BXT, has done a great job this year with the website and making several updates and a complete overhaul of the website including last year's meetings and Dayton Hamfest! Great work Don! Log on to **www.atn-tv.org** and check it out!

ATVQ

## Auckland VHF Group

The January ATV meeting was held the 26th at the QTH of Michael, ZL1ABS.

Lots of surplus equipment was disposed of. The AK ATV tape library was taken over by Andrew, ZL2ALW.

PCB boards for the new model 23cm FMTV modulator were distributed.

CQ-TV magazines from the BATC were available to be read and taken home for study.

A vote was taken on whether the AK ATV Group would buy a channel 39 exciter for Whangarei. The decision was that the AK ATV Group would not buy the equipment. Discussions are under way with amateurs in Whangarei to see if someone in Whangarei will buy the equipment.

Grant ZL1WTT showed the new high power amplifier for the Whitford ATV repeater. It is capable of 20 Watts on a continuous basis. There are two M57762 amplifiers in parallel, using a pcb & parts kit from the RSGB Microwave Committee obtained with the assistance of Andy Emmerson, G8PTH.

New filters are under construction with a GA-AS Fet preamplifier for Whitford.

73 de Michael ZL1ABS

ATVQ





## If You Move

Please send us your NEW ADDRESS! We pay 70 cents for each returned ATVQ. And we are usually nice and send another copy to your new address which costs us $1.29. Please help us from having to do this. Thanks!

# The A.T.N.A. Friday and Saturday Night ATV Dinner Meetings

A.T.N.A. is announcing their Dayton weekend activities regarding Friday and Saturday night ATV sessions. This year we will be back at "The Stockyards Inn", for the Friday night and Saturday night sessions. This will enable ATVers and guests to enjoy a moderately priced meal and also allow more time for technical presentations. The Stockyards Inn will provide separate checks as we order from the menu. There will be door prize drawings throughout the evening. Friday night will be a well structured event while Saturday night will be an informal gathering of ATVers.

Starting at 6PM both nights

**DIRECTIONS**

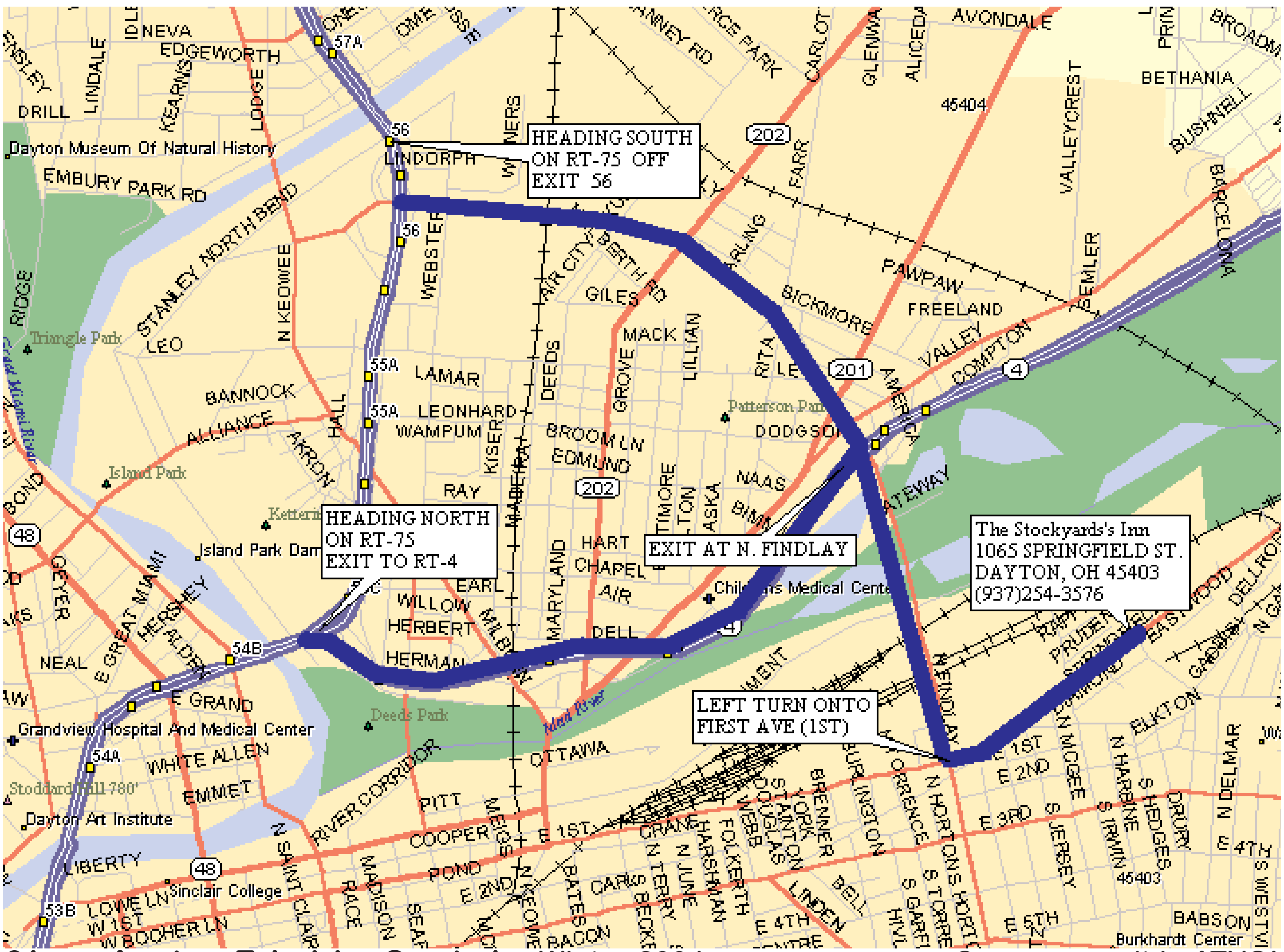
From I-75 North, Exit 56, Stanley Avenue East, at RT-4 the road changes name to N. Findlay Street, at First Street turn left and the road will then merge into Springfield Street. Look for "The Stockyards Inn" on your left . The trip from I-75 is 3.4 miles and should take about 8 minutes.

From I-75 South, Exit onto SR-4 and get off at N. Findlay Street South. At First Street turn left and the road will then merge into Springfield Street. Look for "The Stockyards Inn" on your left. The trip from I-75 is 4.0 miles and should take about 6 minutes.

Please note: Each person will be responsible for their own dinner expenses.

For updates please see the A.T.N.A. Web Page: **www.qsl.net/atna**

ATVQ



# The A.T.N.A. Evening Program for Dayton 2004

## Friday 14 May 2004

**Stockyards Inn**
**1065 Springfield St.**
**Dayton, OH 45403**
**Phone 937-254-3576**

Starting time 1800 Hrs.
Dinner from menu with separate check. Please dine with ATNA.
First Prize Drawing by Art Towslee, WA8RMC.
We will hear about ATV repeaters around the country.
Second Prize Drawing by Art Towslee, WA8RMC
Mike Collis, WA6SVT, and Gary Heston, W6KVC,
will talk about Microwave ATV
Third and last Prize Drawing by Art Towslee, WA8RMC
Upcoming Balloon flights by Bill Brown, WB8ELK
Ending at 2200 Hrs.

## Saturday 15 May 2004

**Stockyards Inn**

Starting time 1800 Hrs.
Informal dining with the ATVers and their friends.
Ending at 2200 Hrs.

# FSATV Forum Speakers Saturday, May 15, 2004, Hara Arena, Hamvention

12:15 - 2:30 Amateur Television .................................... Room 1

Moderator: Bill Parker, W8DMR

Speakers:
Dr. David Clingerman, W6OAL - "Antennas for Rockets, Balloons, and Portable Operation" Horizontally polarized, omni-directional antenna(s), the theory of operation and improvements. A 7 element, circular polarized, Yagi antenna for ground support operation. Dave plans to donate a mini-wheel antenna as a door prize.

Dr. Ralph E. Taggart, WB8DQT - "The New ARRL Image Communications Handbook" Complete with CD-ROM and software utilities, Narrow-Band Television (NBTV), Amateur Television (ATV), Slow Scan Television (SSTV), and Weather Satellite Imaging (WEFAX), the Handbook and a home computer opens the possibilities of many imaging modes. Ralph is donating a copy of his new handbook as a door prize.

Bill Brown, WB8ELK - "Recent Balloon Launches/Retrievals"

Announcements: DARA ATV Repeater Status, W8OFF
ATVQ, Editor, WB9MMM
ATCO, Editor, WA8RMC
ATNA Activities, K3ZKO

# SLOW SCAN TV FORUM 2:45 - 5 p.m. Saturday May 15, 2004

2:45 - 5 p.m. SSTV.........................................................Room 1

Moderator: Dr. Don C. Miller, W9NTP

Speakers:
Mike Tallent, W6MXV
Background and development of SSTV

Yoshi Nishimura, JA6UHL
AOR ARD9800 Digital Voice and Image Interface

Dave Jones, KB4YZ
The Use of Digital SSTV Software (DIGTRX)

Updated information will be available at this URL:
**http://www.tima.com/~djones/forum04.txt**

# Friday Night IVCA SSTV Meeting

Where: Best Western Executive Hotel
2401 Needmore Road
Dayton, Ohio
PH: 937-275-5039

## Friday, May 14, 2004 7:00 PM

Speakers:
Dave Jones, KB4YZ
SSTV-PAL Multi Mode System

Barry Sanderson, KB9VAK
Question and Answer Session on RDFT and
New Modes being tested.

There will be several more speakers such as N9AMR, W9NTP, W8ZCF, W0LMD and others on various subjects.

There will be a general election of officers. Come prepared to nominate names for the election.

Don C. Miller (acting as program chairman)

ELECTRONICS

P. C. Electronics 2522 Paxson Lane Arcadia CA 91007-8537 USA ©2004
Tel: **1-626-447-4565** m-th 8am-5:30pm pst (UTC - 8) Tom (W6ORG) & Mary Ann (WB6YSS)
24 hr FAX order line 1-626-447-0489 Email: Tom6ORG@hamtv.com
Web site: http://www.hamtv.com
VISA MasterCard

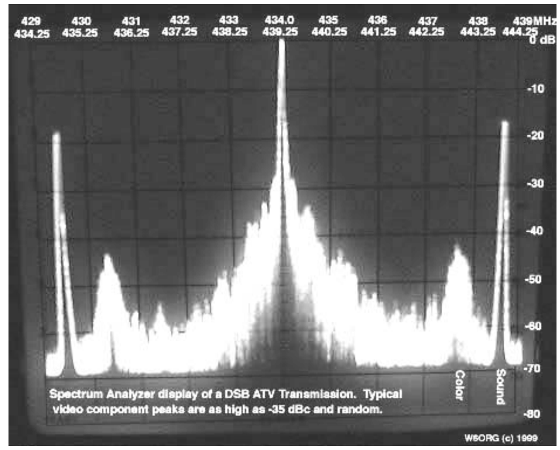
# ATV DSB vs. VSB

**What are the advantages of transmitting DSB or VSB?**

**DSB -** AM Double Sidband**:** Simpler, smaller components, lower cost, and ease of adding amplifiers. Ease of operating on more than one channel and on other than cable channels.

**VSB** - AM Vestigial Sideband**:** Run higher sound subcarrier up to -7 dBc vs. -15 dBc with DSB resulting in hearing sound down to about P2 rather than P3 depending on the TV set. Less interference potential to other mode users with in a few hundred kHz of the lower sideband color and sound subcarriers.

**Power:** There is insignificant difference between VSB and DSB - The amount of sideband power cut off with VSB is less than 1 dB and equals that thrown away in a good VSB filter in the antenna line. VSB is often confused with SSB. With VSB ATV you still have the carrier, upper sideband plus up to 1.25 MHz of the lower sideband video components.




DSB transmitted video modulated with typical camera video. Sound subcarrier at +/- 4.5 MHz is set between -15 and -18 dBc so as not to be cut off during periods of white video. Other significant sideband energy is the 3.58 MHz color subcarrier which rarely gets above -30 dBc. Sync sideband components are donw greater than -40 dBc at +/- 1 MHz.
VSB video would be identical except those components below -2 MHz in the spectrum analyzer photo would be down in the noise below -50 dBc.

**Interference potential of DSB:** Since the video picture amplitude varies with the changing transitions from black to white and all shades of gray in-between a horizontal and vertical sync rate, the actual power at any one given narrow band frequency within the video passband is random and the response time so much lower in a narrow band receiver, that the potential for interference is very low to narrow band modes such as SSB and CW receivers. Therefore the only significant and consistent unnecessary sideband energy is the lower color and sound subcarriers which are already down more than -22 and -15 dBc. This is less than 5% of the total power transmitted. These two spot frequencies are usually unassigned +/- 200 kHz in any local technically generated band plan and give adequate guard band protection to FM voice, packet and SSB modes. A sound engineering band plan agreed to by a technical committee made up of no more than two of the most technically qualified representatives from each of the mode users in the band is a better way to work out the interference potential. Individual cases can be handled on known two meter coordination frequencies - time shift, cross polarize, minimum power as well as filtering to get the ATV sideband power at or below the noise floor in another mode receiver. At the same time, other modes need to have only sufficient preamp and system gain so that off channel transmissions don't overload their front ends per good engineering practice.

Except for Repeaters or at any comm site with more than one transmitter operating at the same time, or the band so full that the lower sound and color frequencies must be used, are VSB filters required for engineering reasons. Some areas require them for more for political reasons or unfounded fear of possible interference.

VSB filters are not practical for R/C, balloons, portable or mobile public service events due to their size and or weight. Cost is also a factor. VSB filters are made for just one frequency so unless all your ATV work is on just one frequency you would have to separate your downconverrter antenna coax to the antenna through a coax relay to bypass the VSB filter to work an inband repeater, or switch VSB filters to transmit on another frequency.

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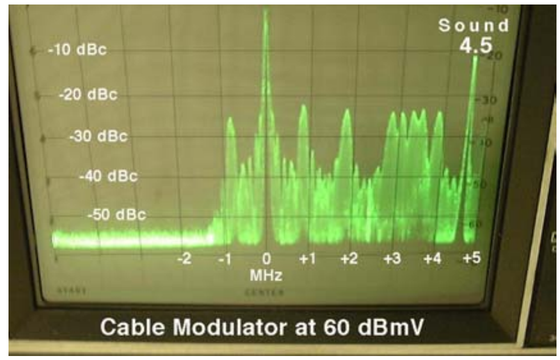
Tel: **1-626-447-4565** m-th 8am-5:30pm pst (UTC - 8) Tom (W6ORG) & Mary Ann (WB6YSS)
24 hr FAX order line 1-626-447-0489 Email: Tom6ORG@hamtv.com
Web site: http://www.hamtv.com

ELECTRONICS

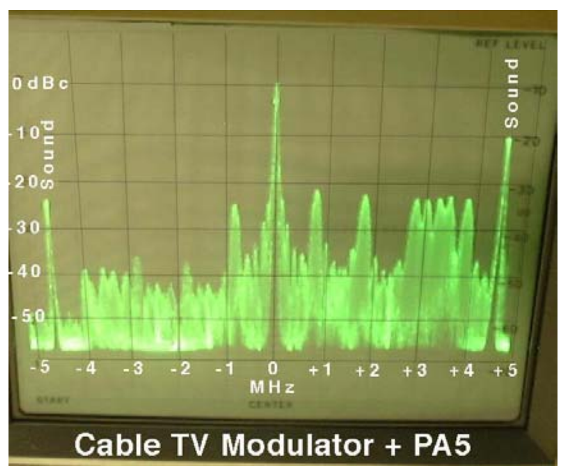
# ATV DSB vs. VSB cont.

If VSB is desired, and you want to run more than a Watt, you will for all practical purposes have to use a VSB filter in the transmitter antenna line. Broadcast TV VSB definition is that these lower sideband subcarriers cannot be greater than -60 dBc. All Amateur "linear" amplifiers intermod products just reinsert the lower sideband sound and color subcarrier components typically to within 10 to 20 dB of DSB. It is not too hard to preserve somewhat of a VSB video modulated RF signal with inexpensive devices up to a watt, but anything higher power costs a lot - Motorola has a nice 60 watt linear amp with 50 dB 3rd order intermod for just under $3000. Even AEA's 50 watt amp when they had them reinserted the lower color and sound subcarriers to with in 10 dB of DSB. So even if you start with a perfect VSB exciter like a cable TV modulator, by the time you boost the power up to something useable for ATV, you will be back to approaching DSB.




ISS Model GL2610-XT Cable TV modulator with a fully modulated multiburst video applied which is worst case for showing sideband energy. Camera video is much less as seen in the previous photo. Note VSB lower sideband and compare after passing through a PA5 20 Watt amateur “linear” amplifier below - set to 10 Watts pep. Lower multiburst video and sound subcarrier are reinserted to about 14 dB of the upper sideband.

To illustrate, we took a professional quality headend cable TV modulator and connected it up to a PA5 20 Watt amplifier and compared the input VSB spectrum to the output. As can be seen, the PA5 intermod products reinsert the lower video sidebands to within a worst case of 14 dB of a normal DSB ATV transmitter, most of which are still about 40 dBc down or only 1 milliwatt out of a 10 watt PEP ATV transmitter. While of no real significance to most areas operating higher in the 70cm band, those on 421.25 would definitely have to put a VSB filter in the antenna line to prevent radiating >30 dBc of energy outside the ham band below 420 MHz. Those in Canada or within the “A” line at the northern US boundary who wished to use 434.0 would likewise need to use a VSB filter in the antenna line. Any ATV repeater would have to have a VSB filter in the antenna line regardless just to prevent intermod mixes in the final with other near by transmitters.




Generally, the higher the amplifier power, the higher the modulation intermod products. This is primarily due to the semiconductors junction capacities changing the dynamic impedance's over the modulation envelope similar to a varicap. Low intermod power devices are designed for low junction capacity and it is not unusual to use a device at a frequency well below its normal range - for example HF SSB linears use devices originally designed for VHF and UHF. The power module used in the PA5 was designed for FM/SSB multimode 70cm transmitters and runs in class AB. Power modules that are designed for class C FM transmitters typically have much worse intermod and in addition have very inadequate bias and supply regulation at the device which causes even more non-linearity. The bottom line is you can start out with a perfect VSB cable modulator plus amp and the receive video will be the same as seen with a DSB transmitter but your sound will still be there with a 2 P unit signal. However, a cable modulator generally does not have an adjustable sync stretcher so you typically have to drive an amp at 1/2 its rated PEP or 1 dB compression point to maintain the video to sync ratio.

W6ORG (c) 2004

# ATV Meeting 2004 In Germany

End of March around 36 amateurs eager to get knowledge about the latest facts on digital ATV gathered in the Wuppertal University invited by Uwe Kraus, DJ8DW (vice chairman of AGAF e.V.). There were many OM from the Ruhrgebiet, but also from Bremen, eastern Germany and Frankfurt.

In his laboratory the chair of communications engineering, Uwe Kraus, presented three examples of DATV usage: 1. GMSK modulated on 70 cm including the working prototype of the GMSK receiver allocating two boards; 2. Live DVB-T in OFDM modulation with a special board needing extra cooling; 3. HDTV demo in 8-VSB modulation (US style) with high resolution video files from hard disk. This had found some publicity on the CeBIT fair in Hannover, Germany, only some days ago.

Lectures were held in an auditorium where video recordings of the Zeppelin DATV transmission at last year`s HAM RADIO fair performed. Uwe, DJ8DW, presented an overview on the DATV development and some supplements like an up-converter for 2,4 GHz, a synthesizer LO, a graphical user interface in PC software for DATV exciter configuration and the special OFDM board. Klaus, DL9KAS, showed pictures of his ATV repeater DB0KWE seated on top of a powerhouse and the original home made board with his new digital ATV output in QPSK modulation on 10 GHz. A second-hand DRO LO from a Satellite TV LNB and SSB transverter components proved stable enough for this purpose, the similar TWT valve PA feeding a 10 dB wave guide slot antenna allowed a DATV range over 70 km already.

After a lunch break Iwo, DG0CBP, sys-op at DB0HEX (Brocken ATV repeater) and ATV specialist in the DARC UHF unit, presented latest facts on German DATV repeaters: there are 17 working or requested, co-ordination is done by the telecom authority in Muehlheim and the DARC office in Baunatal. Iwo is actively developing a linking initiative between many ATV repeaters across Germany, using special hardware and software modules with remote control options. Some devices where shown around, the northern Germany ATV links between Hamburg, Brocken/Harz and Berlin are planned all-digital duplex in the 6 cm- and 3 cm-band. The most southern linking point is in the bavarian alps with extension to Austria, the most western linked repeater is DB0LDK in Wetzlar.

The following yearly AGAF convention showed positive results in the statement of account. A motion on preserving the Winter ATV contest despite of minor participation was welcomed but needs a manager willing to work. The AGAF committee will order a series of 50 up-converter boards for 23 cm DATV. A new internet forum for DATV users installed by Uli, DD1KU, on his homepage found thankful notice, it is linked to the AGAF DATV web pages www.datv-agaf.de

Klaus, DL4KCK

ATVQ

# FCC Experimental Actions In TV Bands

The FCC's latest **"http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-244500A1.pdf"** list of experimental applications granted includes several licenses for operation on broadcast TV channels.

WD2XGW, issued to IPMobilenet Inc, authorizes operation in the 764-776 and 800-866 MHz spectrum for testing land mobile equipment in Irvine, Calif. This includes TV channels 63, 64 and 69. Channel 63 is used in the Los Angeles market by KADY, Oxnard, which has a CP for an 87 kW booster on Mount Harvard, near Mount Wilson. Channel 69 is used by KSWB-TV in San Diego.

OP Corp. was granted license WD2XHI to operate in the 482-608 MHz and 614-770 MHz spectrum for "demonstrations of foreign technologies that can be used for wireless communications services spectrum" at Canonsburg (Washington County), Pa. This spectrum includes TV channels 16-36 and 38-63.

Spacelabs Medical was authorized to "operate indoors" in the 174-216, 402-406, 417-418, 433-450, 450-470, 582-608, 614-645 MHz spectrum for "test and development of devices for export" in Issaquah, Wash.

One other experimental grant that may be of interest to broadcasters is experimental license WD2XHM, for operation in the 12.862-12.962 and 13.1125-13.2375 GHz microwave spectrum for antenna testing, fixed and mobile in Palm Bay (Brevard county), Fla.

See **"http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-244500A1.pdf"** OET Report No. 364, Experimental Actions for a listing of all experimental grants during the period from 1/1/2004 to 2/1/2004.

ATVQ

# Sparks from the Bench

In that article for newcomers is an explanation glossary on page 37 with a wrong PAL field rate. Not 29,94 fields but 50 fields per second is used in Europe, the line rate 15,625 is correct. Some newer TV sets try to enhance the picture by driving the vertical deflection with 100 Hz, but often the needed digital storage circuits are of lesser quality (i.e. 7 bit color range) and downgrade the limited MPEG video even more...

73 Klaus, DL4KCK
Cologne (Germany)

ATVQ

# ATVQ TO PAY FOR ARTICLES!

## Payment for Technical Articles

ATVQ will pay for certain articles that it publishes. I will outline the policy here, but it will be subject to change as needed to make sure that ATVQ continues to be an ongoing publication. ATVQ will pay $25.00 for technical articles that are published and are a minimum of 2 pages. While this is not a great amount, I hope it will encourage more technical type articles to be written. Exceptions will be articles that are written by a manufacturer/seller of equipment that is being written about. While I do not want to discourage this type of article, the article itself is an advertisement of the product. Articles from clubs will be encouraged, and I would expect they would like to share their information with the ATVQ readership. Information gathered from the Internet will not be paid for and is mostly small filler items.

## Ideas

Do you have an idea for an article that you’ve said to yourself that you wanted to write, but never did. Feel free to check with us to see if it is of interest, or write and send it in. No guarantees that it will get published, but if you don’t try, you will never know. I’ll be looking to see what you can do!

# CONTRIBUTORS GUIDE

Preferred method of receiving articles is from **Microsoft Word**, however **Wordperfect** is OK too. Next preference would be **ASKII text**, followed by **typewritten** or **hand written** (clearly). Diagrams or pictures (B&W or Color) can be sent in hard copy, or if you scan them in, save to PCX or JPG formats (actually I can read about anything). If you send a computer disk, make sure it is PC (not MAC) format.

When sending in articles in Microsoft Word, please SAVE with FASTSAVE OFF and save in Word 6 format. Also, articles written in any word processor, consider what will happen when it is re-formatted to fit the style that I might put it in. An example would be setting up tables or adding figures into the article. They can be very hard to strip out. If possible, put the tables, figures, each in a file by itself. This will help me to be able to import into the magazine format.

Articles can be sent to:
**ATVQ, 5931 Alma Dr., Rockford, IL 61108**

or to our email address: **atvq@hampubs.com**
Also note our web page address: **http://www.hampubs.com**

## Olde Antenna Lab

We have added a web page for the Olde Antenna Lab to our web site. The owner, Dave W6OAL, has authored a little piece on the Wheel antennas that are popular with Balloon ATVers which is accessible from the web page by clicking on Wheel that you might find interesting and informative.

Our Rocket and Balloon Application note has been updated after input from Dave on making a reflector for the Big Wheel antenna intended for improving launch site reception and others.
Also Dave has just come out with a 7 element circular polarized beam (7CP-70cm) for those that want the 10 dB gain for greater DX at the launch site or can also be used for satellite work.

Check it all out at www.hamtv.com

Tom O'Hara W6ORG
P. C. Electronics
www.hamtv.com
626-447-4565 m-th 8 AM to 5:30 PM

## ATV Aboard The ISS?

ARISS teams from around the world met in Noordwijk aan Zee, Netherlands from 25 March to 27 March to review progress of the program, determine future steps, and to review projects submitted to the organization for future use. Various committees updated the international team on their progress, while Chairman Frank Bauer presented an overview of the current status of the program and previewed the Roy Neal certificate from the special event held late last year. (Certificates will be sent out shortly.)

Projects submitted for consideration include Amateur Television on the International Space Station. This project would allow for the possibility of mounting an ATV camera on the outside of the station. The Shadow Experiment was presented. More information on this scientific experiment can be found at **http://www.tsniimash.ru/Shadow/default_eng.htm**. A proposal was also made to incorporate the Internet Radio Linking Project and EchoLink into school contacts. Further information on these technologies can be found at **www.irlp.net** and **www.echolink.org**.

Aside from accomplishing general administrative tasks, this meeting gave team members the first opportunity in over a year to meet face to face and discuss the program. The next meeting will be held in Alexandria, Virginia in October. It will be held just after the AMSAT general meeting on 10-13 October. All interested parties are welcome to attend. If you would like to propose a project for the ARISS team, please contact Mike Miller at ka5sma@amsat.org for further information.

## WA9RSO, SK
## Marvin Wall

Marvin Wall (WA9RSO) 62, of Mt. Vernon Illinois passed away on March 14th 2004 at his home. Marvin was one of the first operators of ATV in the Mt. Vernon area and always made a point of promoting ATV at all of the hamfests he could attend. He was the kind of guy who would simply show up at your house with parts you might be missing for an antenna project. He was fascinated with antennas and made and or modified many designs. He was working on one in his shop when he passed. His wit and support will be missed and never forgotten here in Southern Illinois. He is survived by his brother Glen W9TZB also of Mt. Vernon who also is an active ATV'er.

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