

# CQ-DATV

dotMOBI

## Issue 84 - June 2020



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**This is your free ATV magazine.  
Please consider contributing an article!**

### Production Team

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Welcome to issue 84 of our electronic ATV magazine.

When we first started CQ-DATV back in February 2013, we serialised the construction of an ATV repeater for the 10GHz band (GB3FY).

John G3RFL was the brains behind this analogue ATV repeater and some of his moves were not the standard building blocks of an analogue ATV repeater so left us wondering if it would work! The most memorable was the YIG transmitter. As far as we know this has never been done before, or since.

John did get the repeater built with a little help from his friends and a famous TV comedian and found a site. Sadly, the repeater is now off the air. The technology has not let it down and the site has not evicted the repeater. It comes down to an arson attack!!! The site is a museum (analogue is ancient) that raises funds for Autistic Children which asks the question who would deliberately try to destroy something like that? GB3FY is probably not the focus of the attack but just collateral damage.

Another long running series has been Trevor and his GVG 100 panel, a smaller version of the one used to destroy the planet Alderaan in the original Star Wars film. Maybe not the Empire but certainly Trevor has struck back and now has it controlling the software package Vmix, which many of you will be familiar with.

Trevor started controlling the full working time limited Vmix download, which has now done what it says on the tin and expired! Trevor has had to move on to the free demo version which might be missing a few bells and whistles that Trevor would love to see the panel controlling, but these things happen. The software has been demonstrated on the CQ-DATV Facebook site and looks very impressive.

There is a file (GVG15. zip) available on the CQ-DATV download site which contains the full documented source code of both Trevor and Mike G7GTN's efforts so you can follow in their footsteps and restore and adapt one of these surplus panels.

Another repeater story from our resident guru Jim Andrews, KH6HTV, again an analogue repeater using an FM-TV transmitter at 5.9 GHz. This takes full advantage of the low-cost transmitters being developed for the drone market. They are available from many sources on the internet, including Amazon and eBay. It uses FM-TV modulation with a 6.5 MHz sound sub-carrier coupled to a 2-watt PA.

While some of our team are looking at increasing power, John G3RFL is going in the other direction and has a very professional attenuator in bits on the workbench. It would seem age has taken it's toil and John is busy breathing new life into the unit.

For a digital ATV magazine we might be sounding a little analogue focused, Jim when he is not building a 5.9Ghz ATV repeater has come up with an idea of an ATV repeater that is both analogue and digital by using the same rf linear power amplifier and antenna, but adding a 3dB power combiner to the input of the amplifier and feeding it with two modulators, one analogue and one digital.

If that's not enough Jim has been investigating replacement crystals for TV transmitters. It seems these components, once the staple diet of all Radio and TV hams, are now becoming hard to source.

Just to round off with, John has been splashing the cash he is saving while the pubs are closed under lockdown on a Baofeng GT-3TP transceiver. This is a £30 item and is delivering dual band operation and more.



One from the Vault looks back on the original switching, fade to black unit that uses two paths, one for sync and burst one for video so it can fade just the video and not the sync and burst.

Trevor explains this was built out of a necessity to produce a video cut down for a presentation at very short notice. There are many copies and adaptations around, but this was the original design that sparked them all off.

So, another full magazine for you to sit back and enjoy.

Can we also remind you that contributions are now open for CQ-DATV 85. Its only 30 days away and time does have a habit of flying past even in lockdown. Do not just read what others are doing, think about penning a contribution of your own.


In the meantime, we have the CQ-DATV Facebook site for everyone to keep in touch and if you are taking part in the coming IARU ATV contest, the best of luck from the CQ-DATV production team.

## CQ-DATV Production team

**Please note: articles in this magazine are provided with absolutely no warranty whatsoever; neither the contributors nor CQ-DATV accept any responsibility or liability for loss or damage resulting from readers choosing to apply this content to theirs or others computers and equipment.**

# MiniTiouner-Express

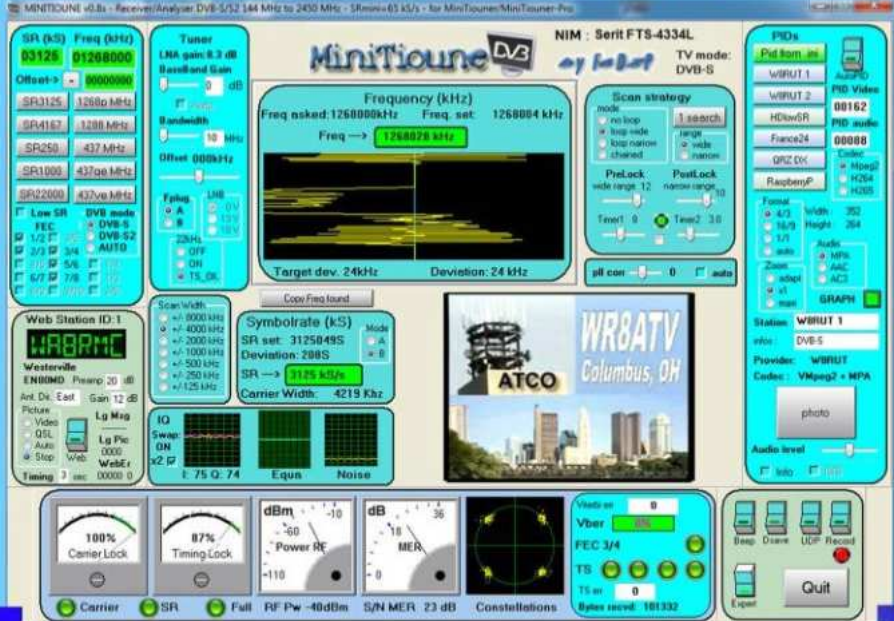
## Digital Amateur Television DVB-S/S2 Receiver / Analyzer



Available at [DATV-Express.com](http://DATV-Express.com)

- Operates with Windows PC using free MiniTioune software from Jean-Pierre F6DZP
- Smaller than a stack of 2 decks of cards (picture above is full size)
- Two independent simultaneous RF inputs with internal preamps
- High sensitivity -100dBm @1288MHz – at 1/2 FEC
- Fully assembled/tested in aluminum enclosure
- Covers 144-2420MHz (ideal for Space Station DATV reception)
- Symbol rates from 75 KSymb/s to >20 MSymbols/sec
- Uses external 8-24VDC supply or +5V from USB-3 port (with small modification)
- Real time signal modulation constellation & dBm signal strength display
- Price: US \$75 + shipping – order with PayPal

For details & ordering go to [www.DATV-Express.com](http://www.DATV-Express.com)



(MiniTioune display above is the ATCO 1268MHz DVB-S repeater signal at WA8RMC QTH 15 miles away).

### Stop the Presses!! – NEW, Improved PXO Discovered!!!

In the Boulder Amateur Television Clubs April newsletter, issue #41, they reported on the work of John, WB0CMC, Dave, AH2AR, Tom, W6ORG and Jim, KH6HTV to come up with a PXO, crystal replacement for PC Electronics, AM-TV transmitters. At the time, they had found a satisfactory, but not perfect PXO.

Since then, John has made a major discovery. He found a PXO from Silicon Labs which is a Perfect replacement for a crystal. It has the same identical phase noise performance as a crystal. To find out more about this fantastic discovery, read the article later in this issue.

### IARU Region 1 ATV Contest 13/14 June 2020



The IARU Region 1 ATV Contest will go ahead on the weekend of 13/14 June.

However, due the COVID-19 crisis not all participants will be able to reach their portable sites, and some may feel that they are at a disadvantage in only being able to operate from home due to National restrictions.

To address these concerns, the contest will be run with 2 sections:

Section 1 will be for participants operating from their registered home QTH. No change of operating location will be permitted during the contest for entries in this Section.

Section 2 will be for participants operating away from their registered home QTH at any time during the contest. So, even if you operate from home on one day and a portable

location on the second day, if you want to add the scores under the rover rule, you must enter Section 2.

Please use the normal entry spreadsheet

<https://wiki.batc.org.uk/images/d/d5/ATV-contest-log-callsign-20190608.xls>

and state in the address box whether you are entering Section 1 or Section 2.

Dave, G8GKQ, IARU Region 1 ATV Contest Coordinator.

### Silicon Dust HDHomeRun QUATRO 4K ATSC3-0



I don't know how many of you have been following this development, but Silicon Dust is preparing to roll out an Internet tuner that will receive the new ATSC 3.0 format.

Silicon Dust has been offering Internet tuners for many years. I've never owned one, but they have a good reputation.

I also know of one ham who had one at a mountaintop location to receive out-of-market TV programs and he liked it very much.

Their "QUATRO" series has four tuners in one box and stream the video back via the web, via a WAN or a LAN. To date, the units can receive NTSC, ATSC 1.0 and QAM (cable) channels. Silicon Dust was considering developing an ATSC 3.0 version, but weren't sure of the level of interest in the market.

Well, a few months ago they began a "Kickstarter" program that would allow people to pledge funding to cover the developmental costs. If they received enough pledges to start the project, they'd begin the development. If not, the donors wouldn't have their credit cards charged. The donors get the first units off the line.

Well, they exceeded their fund raising goal in no time at all and pledges continued to pour in. Things progressed nicely and they just received their first "hardware sign-off samples." If everything checks out, they'll be ready to start production as soon as the firmware and software are ready.

<https://www.kickstarter.com/projects/.....>

What does this mean for DATV? As one of the pledgers, I contacted Silicon Dust to suggest that as they develop the software, they make it possible to tune the receivers outside the North American UHF broadcast television band. I cited hams involved in DATV experimentation as a potential additional customer base as a reason for doing so.

I quickly received a reply from one of their engineers informing me that they had already incorporated that capability in the unit!

"Hi Dan,  
The HDHomeRun QUATRO 4K can tune frequencies up to

1GHz by entering a frequency in Hz. . . ."

This means the QUATRO 4K can be tuned to both the 70 cm and 33 cm ham bands for experimentation. I don't know what the final price of this box will be, but you can pick up one of the current crop of QUATROs on Amazon for around \$150.

<https://www.amazon.com/SiliconDust-HDHR5-4US-HDHomeRun-Connect-4-Tuner/.....>

Thought I'd bring everyone up to speed. Stay tuned!  
73, Dan Rapak WA3ATV

**Source: DigitalATV@groups.io**

***The CQ-DATV editors gratefully acknowledge  
all those authors that have contributed  
articles for this free magazine.***



# CQ-DATV

**ALL BACK ISSUES  
AVAILABLE**





## Arson at Farmer Parrs!!

Written by Trevor Brown G8CJS



As a result of an arson attack at Farmer Parrs Heritage Museum (the location of GB3FY) last Thursday evening, John G3RFL's local ATV repeater is now off the air.

Four fire engines attended the blaze and considerable damage to the venue has resulted. The container which housed the repeater got so warm that stored tools melted! At this time, it is unsure if the fund raising venue will close permanently.

The ATV mast will have to be removed as it is unsafe and obstructing any repair work, should this work prove practical.



**The sad remains of this act a of senseless vandalism. Farmer Parrs means so much to the local community and raises funds for Children with Autism**

Sad to lose an ATV repeater, it is not just the engineering but finding a site and wrestling with all the red tape. I will leave the last words to John who says it is a little like taking your dog to the vets knowing it is the end. GB3FY was designed, built, and funded by John and his team.

The design project encompassed all the features the group wanted in a repeater.

For a while, finding the site was a major stumbling block until Farmer Parrs came along. John was introduced to the owner, James Parr, by a friend Syd Little (remember Little and Large the comedians).





The venue housed many popular exhibits from farm equipment to steam rollers and it is a fund raising project for Children with Autism, which is why this senseless act of vandalism has consequences beyond the loss of an ATV repeater.

The ATV repeater was welcomed with open arms by the owner James Parr. The power drain of around 30 watts was a small cost and the repeater team were more than happy to help with numerous electronic repairs and refurbishment of their exhibits, many of which would never have seen the light of day again had it not been for the team.

GB3FY still works, but some of the enthusiasm seems to have waned and 3cms as a band is not for everyone, its hard work and the rewards are small. The unit will probably go on eBay, but we all know how little home constructed equipment



brings. One possibility might be for Lee (John's Son) to investigate if it could find a new home in Harrogate, there already is a site next to the dishes on the American base at Menwith Hill.

As far as Farmer Parrs is concerned it's the end! The mast has come down so that the roof can be repaired and it will not be going up again! GB3FY was a window that kept John in touch with several ATV contacts that won't now be possible, so some of his current dishes will be coming down at the home QTH. Looking on the bright side, its one less thing to worry about when the wind blows and he is sure Janice the XYL won't be too unhappy about a reduction in the aerial farm.

On behalf of the production team here at CQ-DATV we say thank you to John for his work and for taking the time to





### **One possible solution a new site at Menwith Hill Harrogate**

document GB3FY's progress for our pages. It was not just the repeater but a lot of the research and development that went into both the repeater and Johns equipment at the home QTH. I do not think anybody had ever video modulated a YIG before, this was a first. But also, the gearbox rotator that used a car flywheel to rotate a pump-up mast, the mechanical engineering was constructed by the late Alan Critchly and was seen spinning on our Facebook page. Sad times, particularly for the level of technology that went into this project.

One senseless act and months of hard work comes to an end. John thank you from the CQ-DATV production team, we are sure that you entertained and inspired others.



### **The ATV Mast at Farmer Parrs being removed by contractors**

#### **The Team**

John G3RFL, Bob G1EPL, Dave G3ZGZ, Ted G4MXR, Mike G7GTN, Lee M0LMH.

**GB3FY was on the air from the 28th February 2014 to the 1st May 2020.**



## Grass Valley Mixer Conversions - Part 17

**Written by Trevor Brown, G8CJS and Mike Stevens  
G7GTN**



Shortly after CQ-DATV 83 went to press we achieved lift off and are now going with throttle up. The GVG panel is now controlling the software package VMIX. Seeing a panel that was designed in the mid 80's controlling modern DV

effects and production switching video sources that need not be synchronous is a giant leap for Television Engineering.

Vmix is 4k capable. It is just a matter of splashing the cash. The entry level software is a free demo version, limited to four video inputs and one key, the GVG panel works fine with that. The control codes are the same throughout the range of VMIX software options from free to the upmarket 4K version. Vmix can also have its sources assigned to any video file on the hard disc. This will show as a freeze frame when cut it up on the preview monitor and will animate when transitioned across to the transmission monitor.

We can transition the P/V source to the TX monitor in several ways. The GVG cut button will do just that exchange the P/V and TX banks and the back illuminated buttons on the GVG panel will track this. We can select either Mix or Wipe using the buttons above the T-bar on the GVG panel and then trigger the mix or effect by selecting Auto-Trans.

The DVE effects can be selected using the GVG wipe selector buttons. The LCD screen will show the VMIX name for the effect on the top row and the selected source on the P/V bank on the second row.

This replaces the PGM information on the earlier software as it is deemed less useful to know what is on air (too late to make changes) and more important to show what is about to happen while you can still make changes.

The Red PGM buttons on the GVG panel are also active so you can cut any source up direct without previewing it, again the back illuminated buttons will track the source.

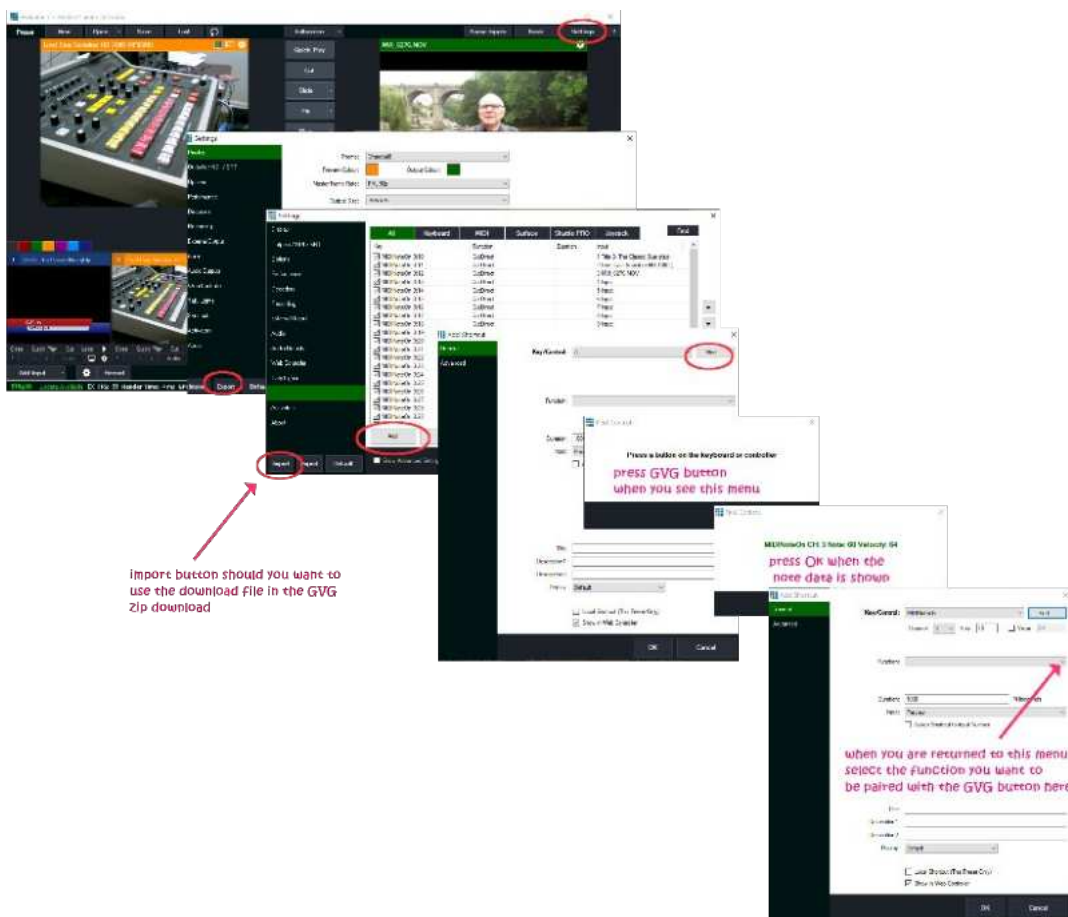
This is all controlled by the ESP module running Annex BASIC, making it extremely easy to customise any LCD legends or change the control function of any of the buttons.

It does not stop there, VMIX can record the output of the mixer as a video file onto the hard drive. This is controlled by the positioner button (start recording) and reverse button (stop recording) both are small LED topped buttons next to the Joystick. This is especially useful should any editing or uploading of the file be required and a big leap from the facilities provided by the original GVG crate.

The Vmix software will also enable live streaming. All this is one giant leap and provides the GVG control panel with a new lease of life while keeping the broadcast look and feel of this impressive panel.

The interface works by a range of buttons on the control panel sending an I2C command to address 7 (which has been given the label of MIDI in the Annex BASIC software) and this is converted to a corresponding MIDI command in the Arduino module and passed to the VMIX software where the MIDI settings carry out a corresponding function.

The MIDI settings are selected in Vmix by the top left button Settings, followed by Shortcuts on the left of the dropdown and then Add. Find is on the top left will present the pop up "Press a button on the Keyboard or controller". This is your prompt to press a button on the GVG panel.



## Pairing a GVG key with the Vmix MIDI settings

The pop up will display the key MIDI info and OK will close it so you can select its function.

Example: **Settings – Shortcut – add - find** will bring up the dropdown **“Press a button on the keyboard or Controller”**, press PGM 1 on the GVG and you will be returned to the **Add Shortcut** menu with **channel 3 note 20** in the boxes. Select the function drop down and select **Cut Direct** (it is in transitions) in the input box, select 1 and it will return you to the settings menu and display.

MIDINote on 3:10 and the GVG button PGM 1 is now linked to

GVG button	I2C data sent to MIDI	Arduino note	MIDINoteOn	Input
PST1	20	Ch3 note 20	Preview	1
PST2	21	Ch3 note 21	Preview	2
PST3	22	Ch3 note 22	Preview	3
PST4	23	Ch3 note 23	Preview	4
PGM	10	Ch3 note 10	Cut Direct	1
PGM	11	Ch3 note 11	Cut Direct	2
PGM	12	Ch3 note 12	Cut Direct	3
PGM	13	Ch3 note 13	Cut Direct	4
Wipe 1	60	Ch3 note 60	Zoom	Preview
Wipe 2	61	61	Wipe	Preview
Wipe 3	62	62	Slide	Preview
Wipe 4	63	63	Fly	Preview
Wipe 5	64	64	Cross Zoom	Preview
Wipe 6	65	65	Fly Rotate	Preview
Wipe 7	66	66	Cube	Preview
Wipe 8	67	67	Cube Zoom	Preview
Wipe 9	68	68	Vertical Wipe	Preview
Wipe 10	69	69	Vertical Slide	Preview
Positioner	58	Ch3 note 58	Start Recording	
Reverse	59	Ch3 note 59	Stop Recording	
Boarder	50	Ch3 note 50	Overlay Input 1 in	
Drop Shadow	51	CH3 note 51	Overlay Input 2 In	
Extrud	52	Ch3 note 52	Overlay Input 3 in	
Outline	53	Ch3 note 53	Overlay input 4 in	
Normal	49	Ch3 note 49	Overlay Input All off	
Fade 2 Black	36	Ch3 note 36	Fade to Black	
Cut	34	Ch3 note 34	Cut	
Fade	32	Ch 3 note 32	Fade	

## MIDI key Assign Chart

Cut Direct 1 and if you have assigned a video file or camera to that source the menu will display it. VMIX will keep this information at power down, so you only have to set it up once.

You can select the rest of the keys in this way, but there is also an import/export function so I will include a file of my settings that you can import in the download zip file GVG15.



Not all the keys on the GVG are linked to MIDI so it's best to follow the MIDI assign key chart. You can add additional buttons that do not have a MIDI link, but that will require additions to the GVG BASIC software.

Working with a free version of VMIX is difficult, for example, Boarder will bring up Overlay one and Normal will clear it the other three adjacent buttons (Drop Shadow, Extrud, Outline will manage the other Overlays but they are not enabled on the free software! They have been included and require testing by somebody with a full version of VMIX. (sorry the buttons have the wrong legend - VMIX and the GVG crate have different functions)

In the Annex editor there are some routines that may be useful that have an apostrophe in front of them to make them inactive, remove this and they will function.

Removing the apostrophe from line 116 will enable a display of the softness pot setting from 0 to 255. 117 will reveal the hue pot setting and 118 the chroma pot setting. The T- bar will need the same treatment but in lines 11 and 660. Line 872 will reveal button command numbers sent to the Arduino. You will need the free Annex editor to see the line numbers and make changes. The BASIC code can be viewed in notepad, but the line numbers will not be displayed.

Some of the buttons on the GVG are housekeeping e.g. you can select mix or wipe, they are a toggle so only one will be illuminated at once and it will enable you to select Mix or DV effects when you press Autotrans.

The T-bar is enabled by the effects Key next to it and this will go out if you pull the fader fully down. This is not linked to VMIX, that is an ongoing development. Only one function at once is allowed so activating the fader will stop any further operations until the fader is pulled all the way down and the light extinguished.

This is normal on professional production switchers. If you had two cameras half mixed you would normally complete the mix and not just switch one away. This is the start of integrating the T-Bar and VMIX and is an ongoing development that has not yet been fully developed in GVG15 software.

The BASIC software and the ESP module cannot deliver the MIDI data required by VMIX, so we have had to add a second processor. This is a Pro Arduino which Mike has programmed to be the I2C to MIDI translator, presenting a protocol that VMIX understands.

The PRO Micro module waits for an I2C Command to generate a unique MIDI note that will become user assigned by the VMIX Settings - shortcut menu. Firstly, we have set up a I2C bus address that does not collide with the addresses used on the main GVG control dongle (address 7). We are running the Arduino as a custom slave device; it always needs to look for incoming commands using an Interrupt Service Routine (ISR). This is achieved by calling a function from, out Set up section of code.

```
//+-----  
//+ Hardware  
//+-----  
void setup()  
{  
  pinMode(A3, INPUT_PULLUP);      // Analog from 74HC4067  
  pinMode(15, INPUT_PULLUP);      // Ground for test notes  
  if (digitalRead(15) == LOW)      // Send test notes, 10 second delay between them  
  {  
    midiTestNotes();  
  }  
  Wire.begin (i2cAddress);  
  Wire.onReceive (receiveEvent);   // Incoming data from GVG Dongle  
  Wire.onRequest (requestEvent);  
  mplex.begin();                  // Initialize the 4067 Multiplexer  
  // threads  
  threadReadPots.setInterval(10);  
  threadReadPots.onRun (readPots);  
  cpu.add(&threadReadPots);  
}
```

```
//+-----
//+ Get Numerical I2C Command from GVG Hardware Dongle.
//+ Each button requires a unique value - see keymap.txt for details
//+-----
void receiveEvent (int howMany)
{
  while (Wire.available () > 0)
  {
    byte c;
    byte value;
    c = Wire.read ();
    switch (c)
    {
      case 0:      // Keybus 10 buttons see keymap.txt file for numeric values
        note0();   // Send selected MIDI Note
        break;
      case 1:
        note1();
        break;
      case 2:
        note2();
        break;
    }
  }
}
```

Since this is all running in an ISR we need to ensure that we get out of this routine as quickly as possible ready to return for our new incoming I2C messages.

A switch statement detects what command number has been called and sends the corresponding MIDI note that has been associated.

The MIDI note that is sent is not relevant as such as you can map any number from VMIX, but it makes the Annex Basic code easier to modify and the bigger interaction picture to be seen.

Within the downloaded GVG15 file is a text file that documents the panel button numbers. As an example the first Key Bus button is 0 and hence note zero is transmitted as MIDI via USB.

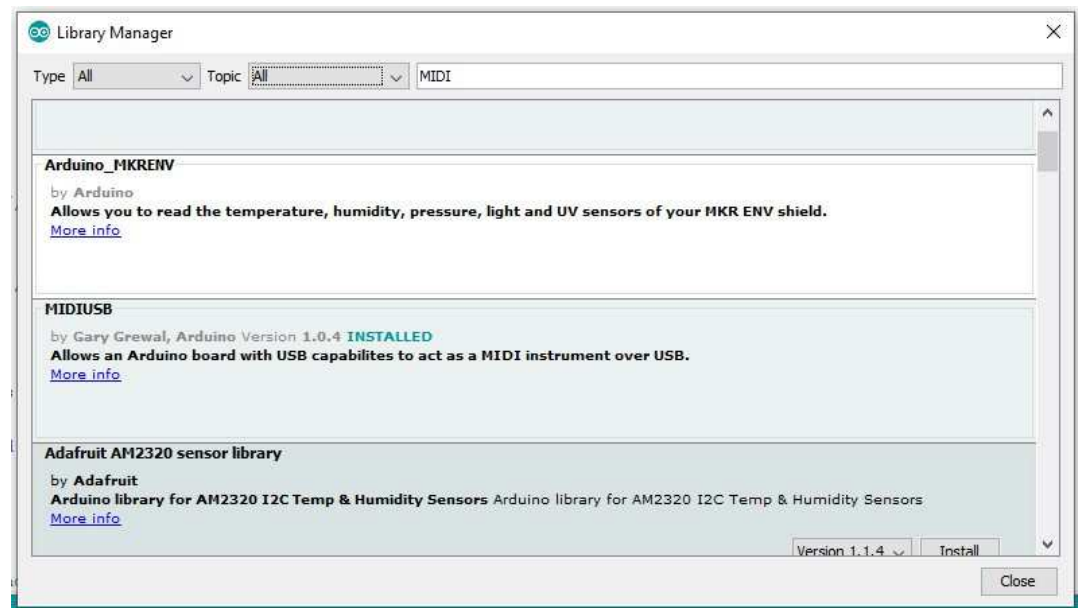
The benefit of this solution is we are not confined to any function as all features can be mapped to your personal requirements.

```
//+-----
//+ Send MIDI Note to VMIX
//+-----
void note0()
{
  noteOn(2, 0, 64);   // Channel 2, note, normal velocity
  MidiUSB.flush();
}
void note1()
{
  noteOn(2, 1, 64);   // Channel 2, note, normal velocity
  MidiUSB.flush();
}
```

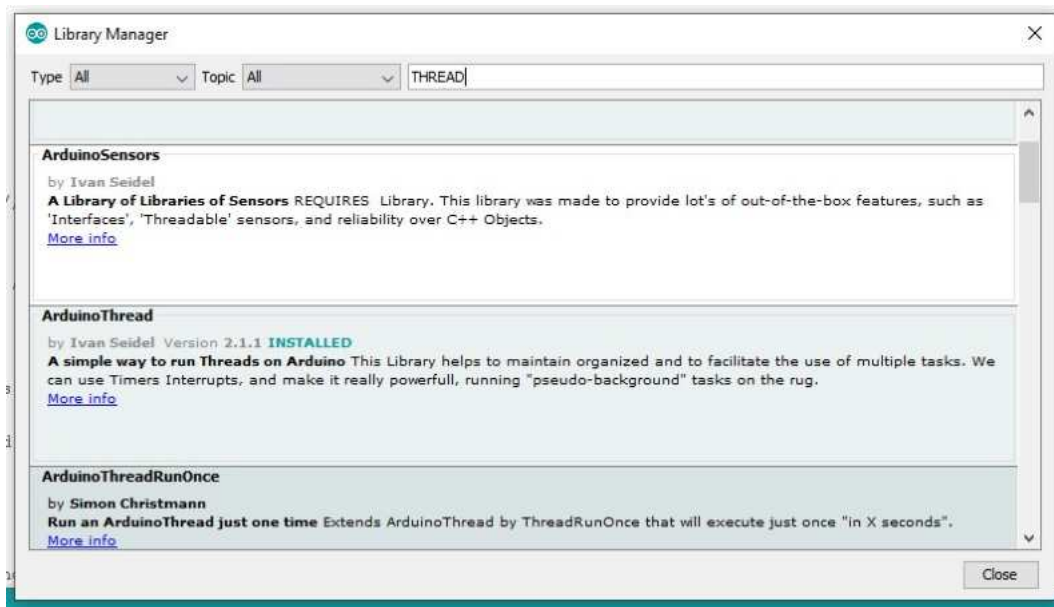
## Extra Libraries installation

As with many Arduino C++ projects, we require additional external libraries. This project requires three. The first two can easily be installed from the Manage Libraries section of the IDE.

The first one turns the Micro in to a dedicated MIDI device that communicates with VMIX. After this one we require the Thread library, this is installed using the same search and install method.







The last library requires downloading from github <https://github.com/sumotoy/Multiplexer4067>. This needs to be installed after removing the Master from the file name. Copy this to your own Arduino libraries folder (default path: user/documents/Arduino/libraries). This Arduino programme is also in the GVG15.ZIP file.

I have placed a video of the GVG panel operating VMIX on the CQ-DATV download site and on our Facebook site.

This project started as a surplus panel that had taken up space in my loft along with one or two other items that I have ideas and plans for. The GVG panel has now come to fruition as a useful item that I will not be parting with. The earlier incarnations of the software that I have released as the project has developed have had considerable downloads, but not much feedback.

The project has limitations in that you need to find a panel and build the interface unit for which Mike was kind enough to design a PCB. Before Mikes PCB it was just assembled on a prototyping board.

The code for the panel control was written in BASIC to which I have added many comments to enable it to be followed.

Where do we go from here? There could be more bells and whistles added to the software to enable more of the functions of Vmix to be controlled by the panel. These are not implemented on the free version of the software and could not be evaluated or tested. The use of BASIC was to enable programmers, or people with a better understanding of code, to develop this project further, perhaps using a more up-to-date language.

The GVG panel is a very professional panel and was much loved by the people that operated it. I was very fortunate in my working life to have operated one live on several occasions to control a night time ITV channel for the transmission of a programme called Music Box. Quite scary pushing the buttons when you know several million viewers are watching your mistakes.

I also operated one mostly via the remote RS422 input in a VTR editing suit, so I suppose I had a soft spot for the GVG panel, back when it actually drove the crate it was designed to control. I only wish I had started this project sooner as several of you have confessed to sending one to the skip or not rescuing one when you had the chance.

I hope the project has stimulated your imagination and that the code downloads are because you are interested and not that it's just pop it on the hard drive should a panel come your way at a future date.

CQ-DATV has provided the platform for me to show you how to develop something that could be useful and might have brought a professional Vmix control surface within your grasp.

There are commercial control surfaces available and they can cost more than £700 and from the pictures on the net I doubt

if they will deliver the look and feel of a professional panel like the Grass Valley.

There is something about operating something designed and built for broadcast use, if you have not been there its hard to explain.

My thanks go to Mike G7GTN who has been my mentor throughout this project from ideas, PCB support and finally the MIDI Arduino interface without which this could not have become anything other than a panel which would respond to button pushes by lighting them up.

Will there be a GVG16 release? Well it would be nice to see the T-bar operational or to be able to scroll through a VTR play-list or recall a pre-programmed strap line for a change of presenters. The list is endless. Also, it would be good to compile a list of TV cameras that will work with Vmix, preferably without interface card.

So far my webcam performs well but there must be others.

No, this is not the end of the project; we will develop it further and between this issue and the next Mike and I will be looking into the T-Bar operation.

## References:

<https://sites.google.com/site/annexwifi/home>

<https://sites.google.com/site/annexwifi/electroguard-lessons/toolkit>

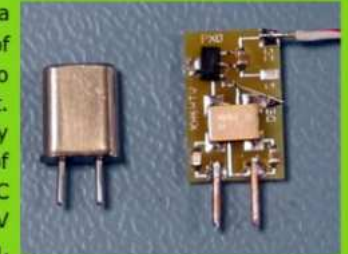
<https://www.youtube.com/watch?v=J-Lr3ziWJ1I>

<https://www.youtube.com/watch?v=ccwK4wW50x4>



## Model PXO-xxx PROGRAMMABLE XTAL OSCILLATOR

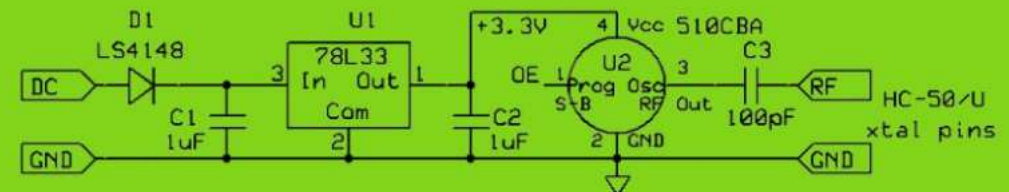
The **NEW** KH6HTV VIDEO Model PXO-xxx is a Programmable Crystal Oscillator. With the demise of International Crystal, it has become very difficult for radio amateurs to obtain replacement crystals for older equipment. To assist in solving this problem, we are offering to supply HC-50/U type oscillators which can often be used in place of the original crystal. We will stock oscillators for the PC Electronics, 70cm, AM-TV transmitters for standard TV frequencies ( [www.hamtv.com](http://www.hamtv.com) ) The price is \$20 each, including 1st class postage. The price for any other frequencies is \$30 each. When ordering, please specify: desired oscillator frequency. The frequency is programmed by the factory. It can not be reprogrammed by the user.



The PXO is a CMOS oscillator running from 3.3V. It includes an on board 3.3Vdc regulator. One of the "xtal" pins, labeled Gnd, goes to ground. The other "xtal" pin, labeled RF, is the ac coupled RF output. Solder a wire to the pad labeled DC. This wire must be attached to a dc power source of +6 to +15Vdc. In the PCE transmitter, the two channel crystal relay provides the ground circuit, thus disabling the power to the unused PXO. For additional details, see Application Note, AN-56a.

Stock Oscillators are available for the following frequencies for use in PC Electronics, 70cm, TV Transmitters. Note: the PCE transmitter output is a 4 X multiplier of the crystal or PXO frequency.

PXO Frequency	70cm Frequency	TV Channel
105.5125 MHz	421.250 MHz	57
106.5625 MHz	426.250 MHz	
106.8125 MHz	427.250 MHz	58
108.3125 MHz	433.250 MHz	59
108.5000 MHz	434.000 MHz	
109.8125 MHz	439.250 MHz	60



PXO-XXX specs. revision 1.0, 4 May 2020

**KH6HTV-VIDEO** [www.kh6htv.com](http://www.kh6htv.com) e-mail: [kh6htv@arri.net](mailto:kh6htv@arri.net)  
Boulder, Colorado, USA



## NEW 5.9 GHz FM-TV W0BTV-TV Transmitter

Reprinted from Boulder Amateur Television Club TV  
Repeater's REPEATER - May, 2020

**Written by Jim Andrews, KH6HTV**

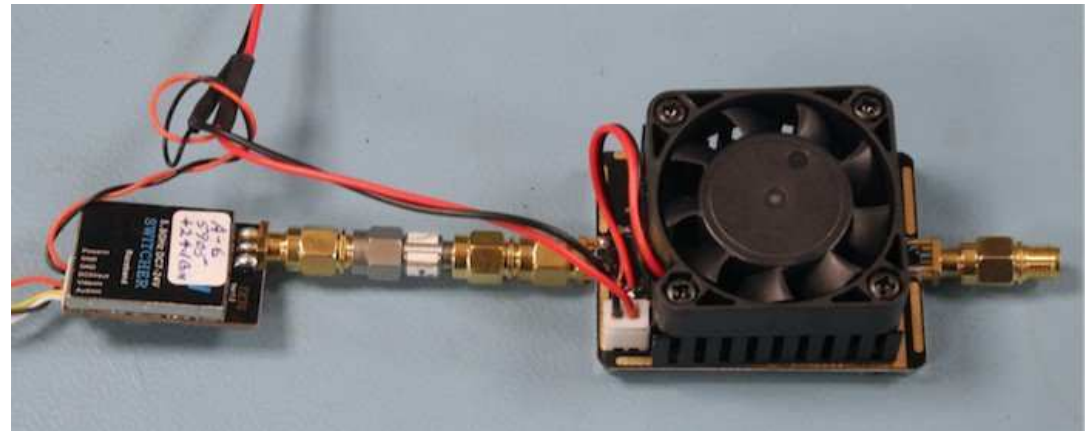
*Please Note: The following article was actually written way back in November, 2019. Jim, KH6HTV and Don, N0YE, had designed and built the new 5.9 GHz, FM-TV transmitter for our ATV repeater. We were delayed in getting it installed due to recurring snow storms which prevented us getting access to the repeater site's roof-top. Then the corona-virus pandemic struck and all access to the government building was forbidden. To date, this new equipment has yet to be installed. Don recently tested the transmitter operating from the parking lot at the repeater site. Jim was able to receive the signal very easily 6 miles away using only a simple rubber duck whip antenna. We thus have decided to go ahead and release the details of the new transmitter, along with RF coverage maps which show where we expect to be able to receive it's ATV signals. - kh6htv*

Our W0BTV ATV repeater now has a new, additional TV transmitter. This is our first microwave transmitter, since the mid 90s. At that time, we briefly had a 2.4 GHz, FM-TV transmitter, but removed it due to severe part 15 RFI. This time we are going to try out another FM-TV transmitter at 5.9 GHz.

This transmitter uses the new, low cost transmitters and receivers marketed for the drone market. They are available from many sources on the internet, including Amazon, E-Bay, etc. The transmitter is analog, transmitting standard definition, NTSC, 480i video and mono audio. It uses FM-TV modulation with a 6.5 MHz sound sub-carrier. The transmitter consists of a model TX- 35, mini-xmit module.

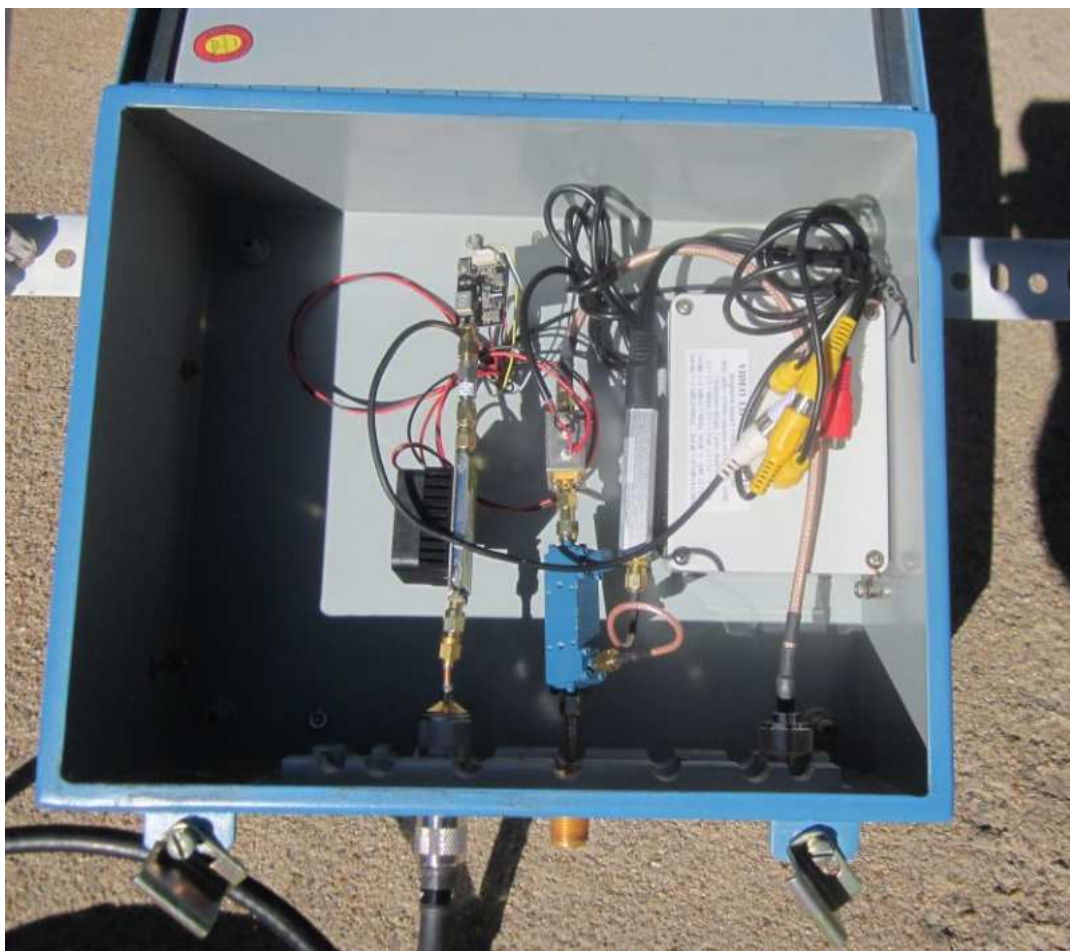
It is frequency synthesized with 40 channels. The TX-35 also has programmable power levels. It then drives a 2 Watt power amplifier. The amplifier is a model TXPA-58002W5. The transmitter's frequency is 5.905 GHz and it's rf output power is +33dBm ( 2 Watts).

The antenna is an omni-directional, horizontally polarized monopole with 10dBi gain. Thus the ERP is about 20 Watts. This transmitter will be operating as a 24/7 permanent, ATV Beacon. When the ATV repeater is not actively repeating ATV signals, this transmitter will continuously transmit the repeater's ID slide show. When the repeater is keyed up, this transmitter will rebroadcast the incoming ATV video and audio, same as the present, 70cm transmitter. As a beacon, it is thus intended for amateurs to use as an experimental signal source to test out your microwave ATV receivers and antennas. If necessary, this 5cm Beacon can be toned off by a repeater control operator.



**The 5.9 GHz, FM-TV, 2 Watt Transmitter - TX-35  
exciter on left, power amp on right**

The block diagram at the end of this article shows all the components used in the transmitter. We are not permitted by our host to run additional cables to the rooftop. Thus, we needed to be inovative in how we added this additional transmitter. Note, there are two seperate portions.



### 5.9GHz, FM-TV Transmitter enclosure & antenna

The equipment on the left in the block diagram is installed in the repeater's 19" rack and located in the radio room. The radio room is on the top floor of the tower, immediately below the roof-top antennas.

The actual transmitter is separate from the rest of the 19" rack mounted repeater. It is housed in a weather-proof enclosure and will be mounted on the roof of the repeater site's south tower building at about 100 ft above ground level. Don, N0YE, assembled this box and antenna bracket and will be installing it soon ( We Hope ! ) +13.8Vdc power

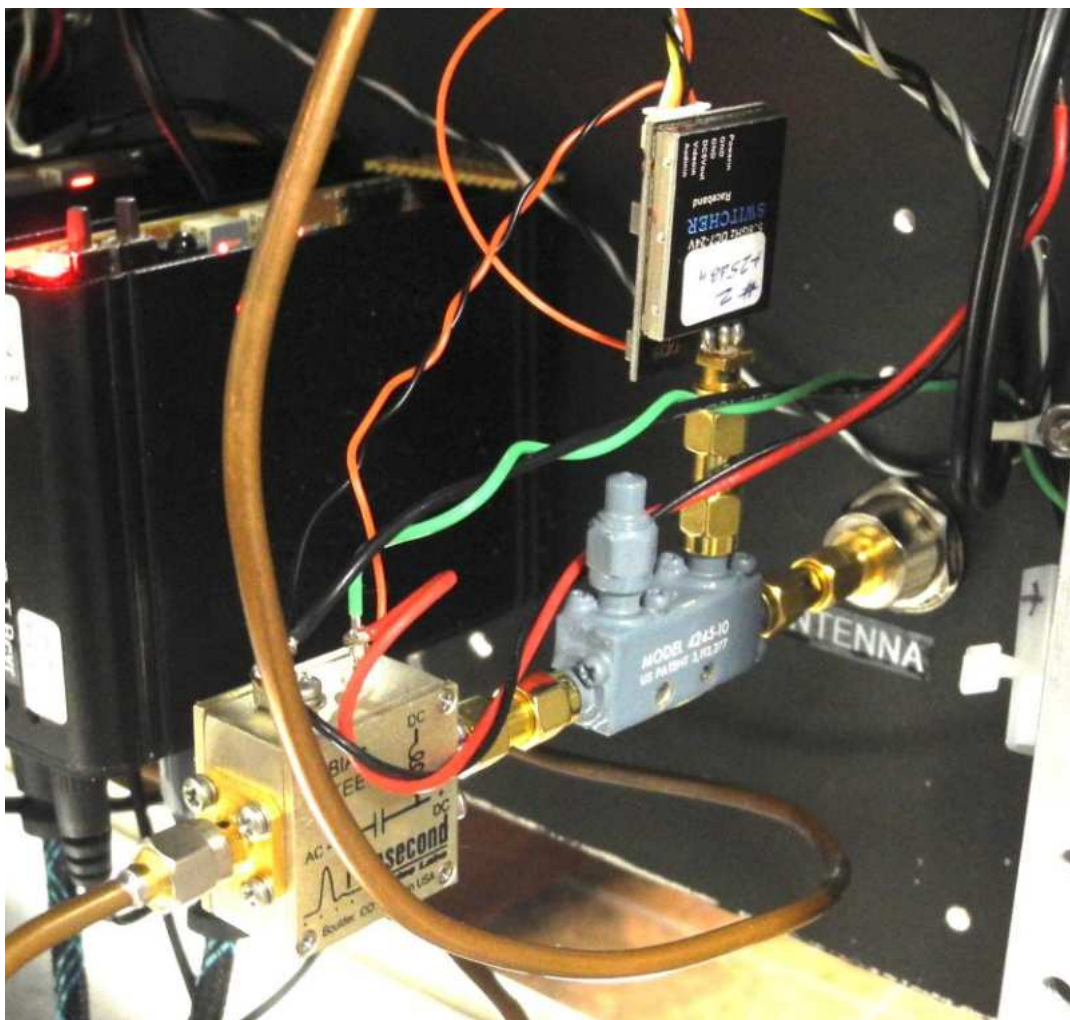


### ...and roof top mounted

for the transmitter is fed up to the transmitter box from the radio room using the repeater's receive antenna's coaxial cable. There are Bias Tees in the repeater rack and also in the 5.9 GHz transmitter box to insert and pick-off the dc power.

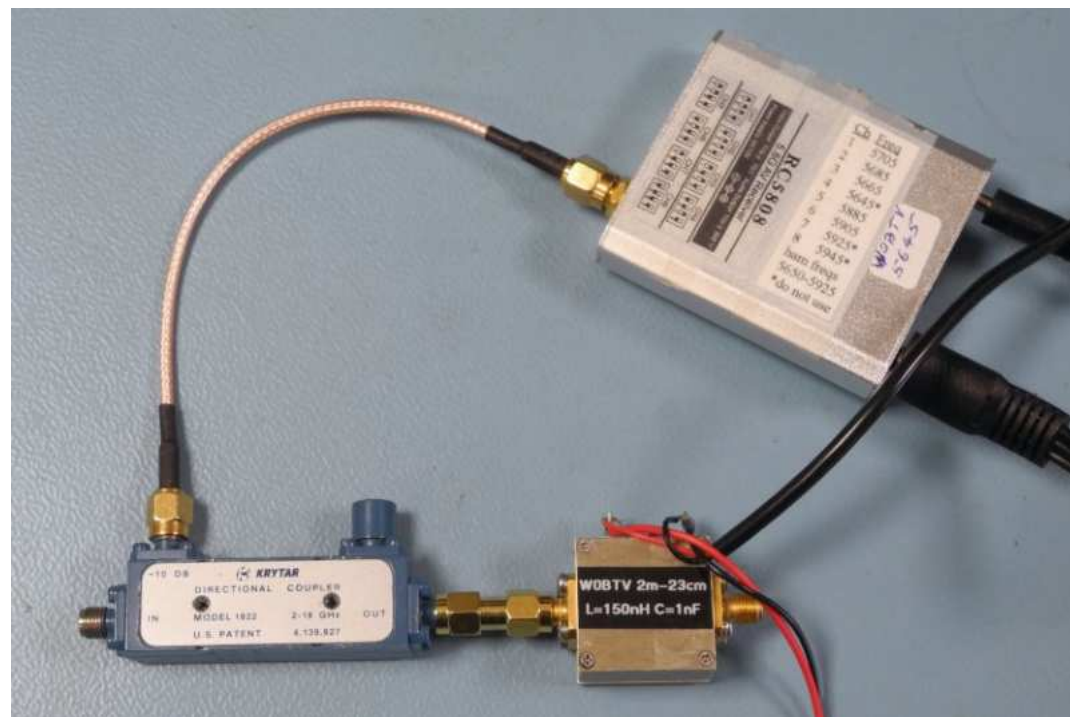
The bias tees are Picosecond Pulse Labs, model 5587. They were modified to optimize their performance for very low insertion loss ( < 0.1dB ) for both 70cm and 23cm. The A/V modulation for the FM-TV transmitter is also fed up the receive antenna's coaxial cable. It is done in a unique, "repeater within a repeater" scheme.





### FM-TV Up-Link showing mini transmitter module, directional coupler & bias tee

Down in the radio room, in the repeater 19" rack, we have a mini, TX-35, FM-TV transmitter module which is driven by the same analog A/V signals which drive the 70cm analog transmitter. This mini transmitter module is on 5.645 GHz and was set for low rf power of +13dBm. This 5.645 GHz signal is then coupled onto the receive antenna coaxial cable using a 10dB directional coupler.



### Up-link FM-TV receiver, directional coupler & bias tee

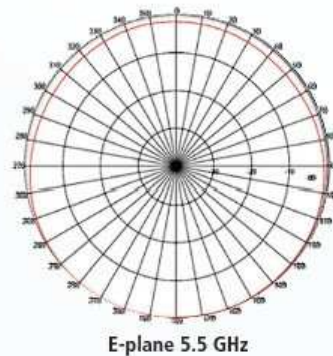
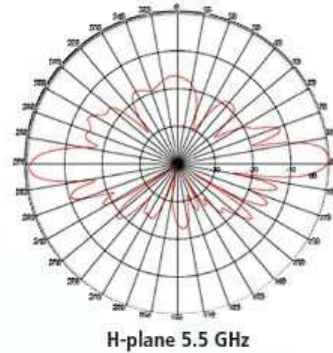
Up on the roof- top, in the transmitter box, there is another 10dB directional coupler to pick off this 5.645 GHz FM-TV signal. It is then demodulated by an FM-TV receiver tuned to 5.645 GHz. The receiver is a model RC- 5808. The composite video plus audio from this receiver then is used to again A/V modulate the 5.905 GHz FM-TV transmitter.

Using this scheme, we are able to get multiple service out of the repeater's receive antenna coaxial cable. Plus, our repeater site host, would not allow us to install more cables. Thus, it was to only way for us to add this new transmitter.

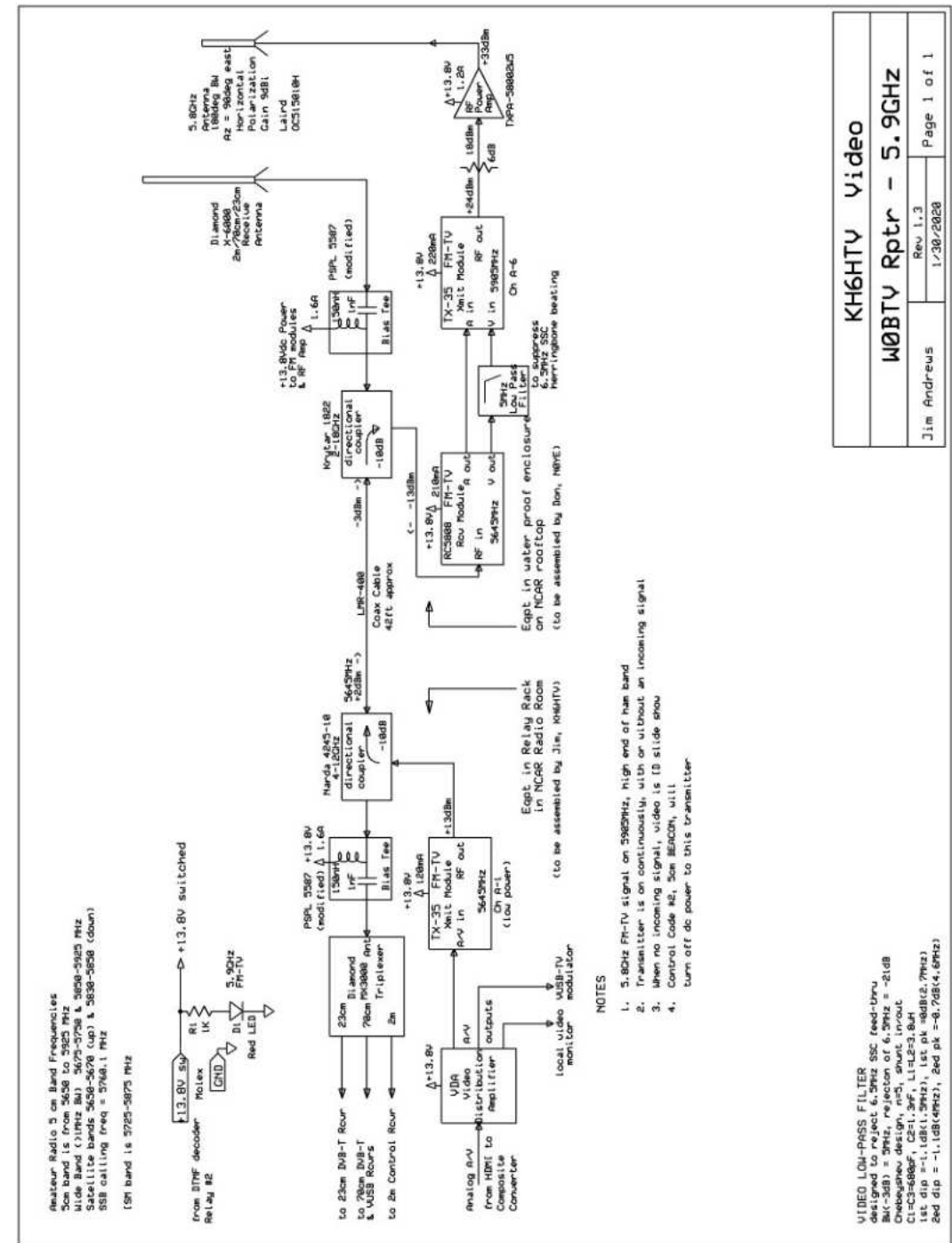
### 5.9 GHz Antenna

For an antenna, we wanted to have a 180 deg pattern to only cover the eastern prarie. We also wanted to use horizontal polarization.

We felt that most Wi-Fi, ISM, etc. activity was probably using vertical polarization. By going to horizontal, we would minimize the RFI from these sources. It took us awhile to find an appropriate antenna. Don, N0YE, first wanted to go with a slotted waveguide antenna. But after he built such an antenna, he had disappointing results. His antenna was very narrow-banded and had only 4dBi of gain. After much searching of the internet, we finally found a suitable antenna.



We had to compromise and go with an omni-directional pattern. We purchased the Laird model OC515010H from Digi-Key for \$60. The mfr's spec. is 10dBi gain with an omni-directional pattern. 10dBi has been confirmed by Don, N0YE, in his antenna range tests. Polarization is horizontal. 9.5 deg., 3dB beamwidth. The antenna height on the building roof-top is approximately 100 ft. above ground level. The coax feedline is LMR-400. The approximate length is 3 ft. Coax loss is approximately 0.4 dB.





## How to Repair a 1 to 99dB Attenuator

Written by John Hudson G3RFL

I was given this attenuator a while back and it started to go wrong so I decided to look into how it works.



There are two barrels 0 to 9dB in 1dB steps and another with 10dB steps very clever in that little error or leakage happens due to its construction.



On investigation I found the zero ohms tube connecting the two tumblers was at fault in that the springs in the plunger had got weak.



To repair this I obtained very small bore brass tubing in a kit and 0.8mm springs on eBay so I selected two tubes that just slide inside each other then added two springs soldered each end and filed a flat on them



Yep it now worked!!

## Multiplexing DVB-T on Top of an Analog, VUSB-TV Transmitter

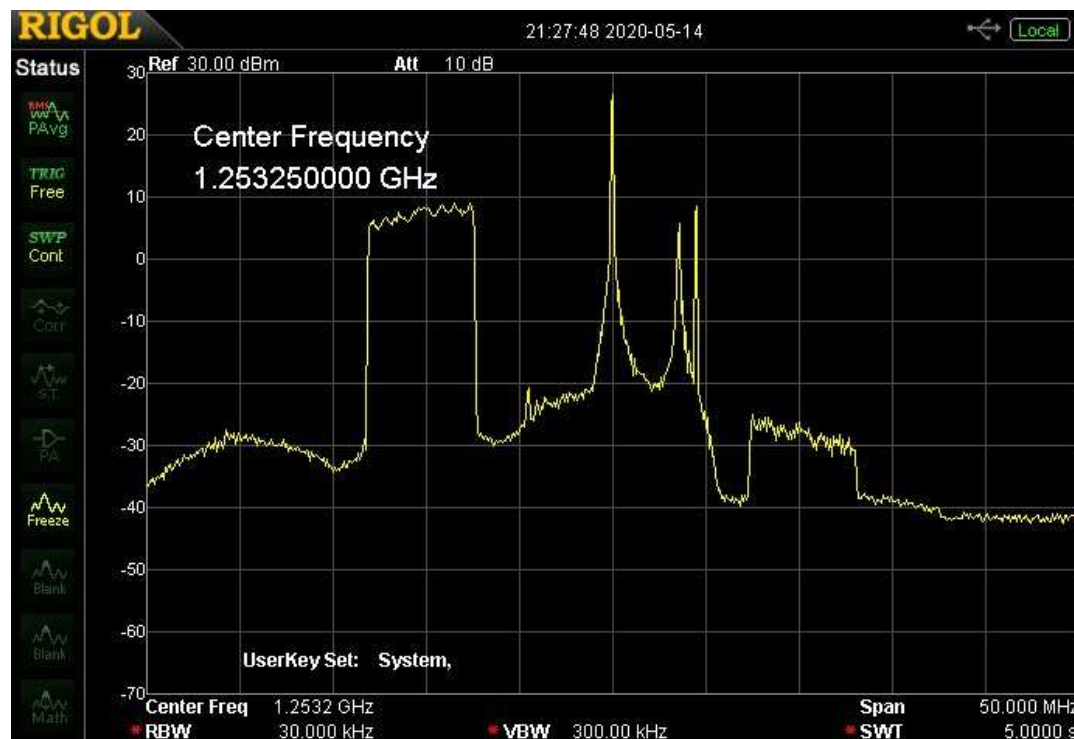
Written by Jim Andrews, KH6HTV

*Reproduced from Boulder Amateur Television Club TV Repeater's REPEATER May, 2020*

I was recently corresponding with some ATV hams that were interested in doing digital TV on their ATV repeater. However, they were encountering resistance from other hams that wanted to stay analog. I suggested that it would be possible to do both. For reception, they could add a second digital TV receiver easily and use the same input channel. After their input band-pass filter and pre-amp, simply add a 3dB power splitter and feed their original analog TV receiver and take the other splitter output and feed a digital TV receiver. For transmitting, use the same rf linear power amplifier and antenna, but add a 3dB power combiner to the input of the amplifier and feed it with two modulators, one analog and one digital. For transmitting, put the two modulators on different channels. Feed the same A/V signal to both modulators for simulcasting analog and digital. This should usually be easier to accomplish on the 23cm band, compared to 70cms because we have there 60 MHz vs. 30 MHz and also typically fewer users

I have setup an experiment here in the ham shack on my electronics test bench to demonstrate the principal. My 23cm experiment put a 1243 MHz, 6 MHz BW, DVB-T, signal on ATV-1 channel (1240-1246). I left ATV-2 (1246-1252) empty as a Guard channel. I then put a 1253.25 MHz, VUSB-TV signal on ATV-3 channel (1252-1258).

By carefully balancing the relative digital and analog rf power levels, the system worked well. I used analog and digital receivers to test the quality of the transmitted multiplexed TV signals. On the digital TV receiver, the s/n meter showed



**Multiplexed, 23cm, ATV Transmitter: Digital, DVB-T on 1243 MHz and Analog, NTSC, VUSB-TV on 1253.25 MHz 10dB/div & 5 MHz/div. rms detector & 30kHz BW**

perfect readings both with and without the analog signal being present. For analog TV, there was a slight impairment in the transmitted signal. On the analog receiver and also using a Tektronix waveform monitor and vector scope, the presence of the digital signal was seen to add a slight amount of extra background white noise. The analog picture went from being a perfect P5 to a very acceptable, P 4.5 picture.

I followed this procedure to set it up the ATV transmitter for the above photo.

**1.** First turn on only the analog modulator. Increase the rf drive level to the final amplifier until one sees the un-wanted lower sideband, as evidenced by the sound and color sub-carriers, start to grow.



Stop when they grow to be -20dB below the upper side-band sub-carriers.

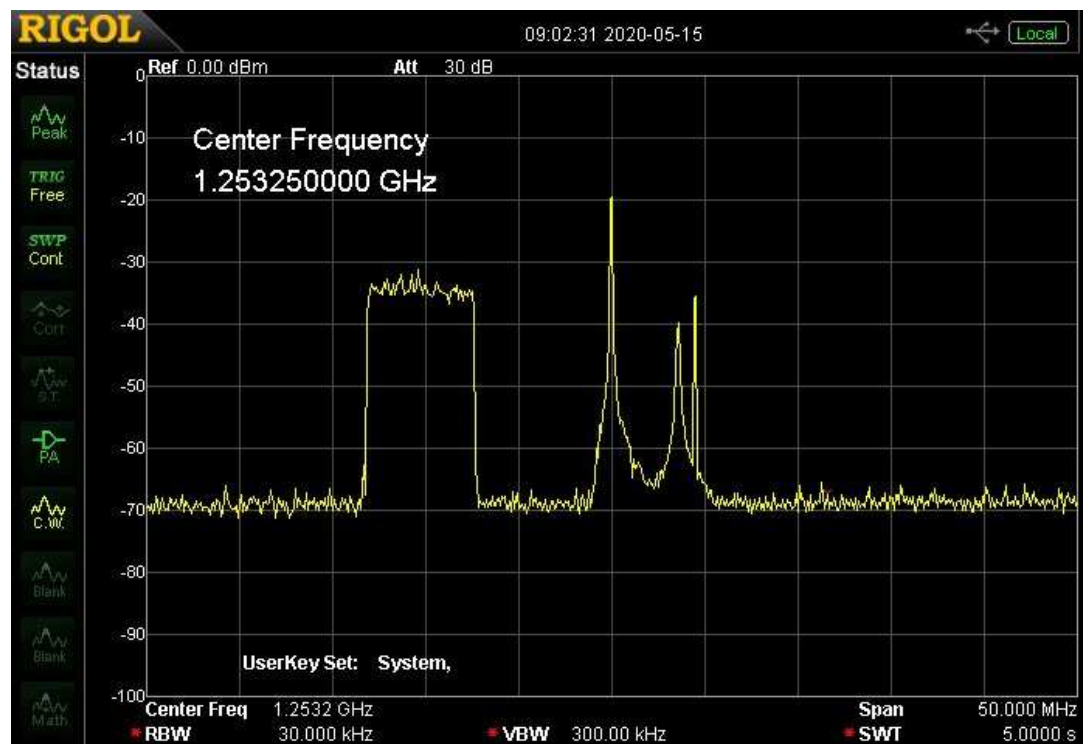
2. Reduce the rf drive power -3dB. This will typically drop the undesired lower side band sub-carriers to -30dB below the upper sideband sub-carriers.
3. Next measure and record the analog rf output power of the transmitter. Measure it as the PEP on the sync tips.
4. Turn off the analog modulator and turn on the digital modulator.
5. Increase the digital rf drive level until the rms output power of the transmitter is -8dB below that of the analog PEP power level.
6. You can now turn on both modulators. The result will be similar to that shown in the above photo.

For the example shown. The resultant analog TV rf power was 5.6 Watts (PEP). The resultant digital TV rf power was 850 mW (rms). The non-linearities in the amplifier were seen to generate an extra, low level digital signal in the next TV channel above the analog channel. It is measured to actually be -66dB below the analog TV signal's video carrier. In the guard channel between the digital and analog TV signal, the residual digital noise is about -60dB below the video carrier. Note: This is using the rms detector and gives to rms power in a 30kHz bandwidth.

The sacrifice in TV transmitter power made by multiplexing versus using it strictly for analog or digital, is lowering the analog PEP power by -3dB and the digital rms power by -5dB.

## Test Set-Up

My multiplexing test set-up used a Blonder-Tongue ACM-806,



## The input multiplexed signal. Digital, DVB-T on 1243 MHz and Analog, NTSC, VUSB-TV on 1253.25 MHz 10dB/div & 5 MHz/div. rms detector & 30kHz BW

CATV modulator and a Hi-Des HV-320E modulator to generate the analog and digital signals. The CATV modulator was set to channel 9 ( 187.25 MHz). I used my model 23-6 Up-Converter to put the analog signal on 1253.25 MHz. I set the HV-320E directly to 1243 MHz. I combined the two signals using a Mini-Circuits 3dB splitter/combiner. The 3dB combiner output is shown above.

I used my model 23-11A as an example, 23cm linear rf power amplifier for this multiplexing test. To instrument the resultant, amplified 23cm multiplexed signal, I put a 50 watt, 30dB attenuator on the amplifier followed by a 20dB directional coupler and then into my Rigol spectrum analyzer to monitor the spectrum.

I used the directional coupler output to a 30dB attenuator and a 3dB splitter to provide test signals for the analog and digital TV receivers. The digital receiver was a Hi-Des HV-120.

To receive the analog signal, I used my model 23-7 Down-Converter to a Drake DMM806, CATV receiver tuned to channel 9. I analyzed the analog video output using Tektronix waveform monitor and vector scope, plus a JVC studio monitor.

For those who can't work out social distancing. This is two meters apart !! 😂



Thanks to Peter Benito Mc Farland

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Ein neuer QO-100-Downconverter der AMSAT-DL  
(Siehe Bericht auf Seite 9)

Aus dem Inhalt: Rückblick auf das AGAF-Jahr • 47-GHz-ATV-Versuche • Bericht vom AMSAT-Symposium in Bochum • Ein neuer QO-100-Down-Converter • Medientage in München • Kapazitätsmessung an Alkaline-Batterien • ATV-Nachrichten • Blick GB: DATV-Demo in Ostfrankreich

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## Replacement for Crystals - PXOs

**Written by Jim Andrews, KH6HTV with significant contributions from especially John Gebuhr, WB0CMC, also Dave Pelaez, AH2AR and Tom O'Hara, W6ORG**

"Where can I buy crystals?" This is a lament heard often from hams owning older ham gear. Crystals were a very necessary item in many ham transmitters and receivers. The major supplier for many years, since 1951, was International Crystal Manufacturing (ICM) in Oklahoma City, OK. ICM went out of business in 2017. They were the last manufacturer in the US that made crystals to order in quantities as little as a single piece, and most recently, at a cost \$35 each.

Don, N0YE, has just made an inquiry to the Microwave Reflector inquiring about sources for crystals. This search has now found a few crystal manufacturers that will make custom crystals in small quantities.

In the USA, it is Bomar [www.bomarcystal.com](http://www.bomarcystal.com). Bomar however requires a minimum order of \$100. In the U.K., it is QuartSLab [www.quartslab.com](http://www.quartslab.com). They offer more reasonable prices of about \$35 for a single crystal. In the Czech Republic, it is Krystaly <http://old.krystaly.cz/index.htm>. It has been reported that Krystaly's crystals sell for \$22. It is also reported that QuartSLab & Krystaly take credit cards and will ship to the USA. There may also be others ?

For the amateur TV market, the major supplier for many years has been Tom O'Hara, W6ORG, of PC Electronics [www.hamtv.com](http://www.hamtv.com), Arcadia, CA. All of Tom's AM-TV transmitters, prior to 2004, were crystal controlled.

In 2017, when ICM announced their closing, Tom and I were discussing options. With Tom's big installed base of thousands of his TV transmitters, he needed somewhere to refer hams to get crystals for them.

I mentioned Programmable Crystal Oscillators (PXO) as an option. At the time, we agreed that I would investigate their possibility for use in Tom's TV transmitters. I purchased some Epson PXOs for experimenting, but found they did not work well in PCE transmitters. They had spurs in their spectrum which caused horizontal tearing of the TV picture. Thus, we lost interest and dropped the project.

Most recently, in the BATVC newsletter (issues #33 & 38), we had two articles from hams about using PXOs in PCE transmitters. The hams were Dave Pelaez, AH2AR, Dayton, Ohio and John Gebuhr, WB0CMC, Omaha, Nebraska.

This revived Tom, W6ORG's interest in pursuing using PXOs as replacement crystals in his TV transmitters. So, as a result, Tom, Dave, John and I have been having four way, e-mail conversations on the topic.

John and I in particular have been evaluating several PXO models and comparing results. We evaluated several models from Epson and found them to be unsatisfactory for various reasons. The Epson models evaluated were the models: SG-8003, SG-8002 and the SG-8101.

Finally John found a "winner" from the company Silicon Labs. It was their model 510CBA. Figs. 1 & 2 show the measurements of the phase noise of the various PXOs and for comparison an HC-50/U, 5th overtone crystal. They were all measured in the same oscillator circuit shown in Fig. 3.

This oscillator circuit is similar to those found in the PC Electronics AM-TV transmitters. The 510CBA's phase noise is almost a perfect replica of that measured from the crystal. The only difference noted is very tiny spurs at  $\pm 425$  kHz that are -80 dBc.

The issues with the Epson PXOs were related to unsatisfactory phase noise and spurs.

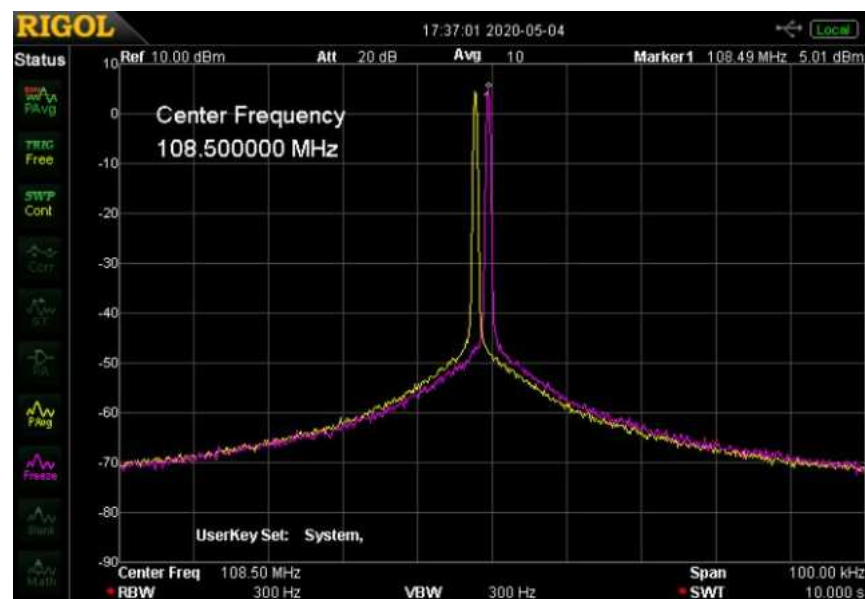
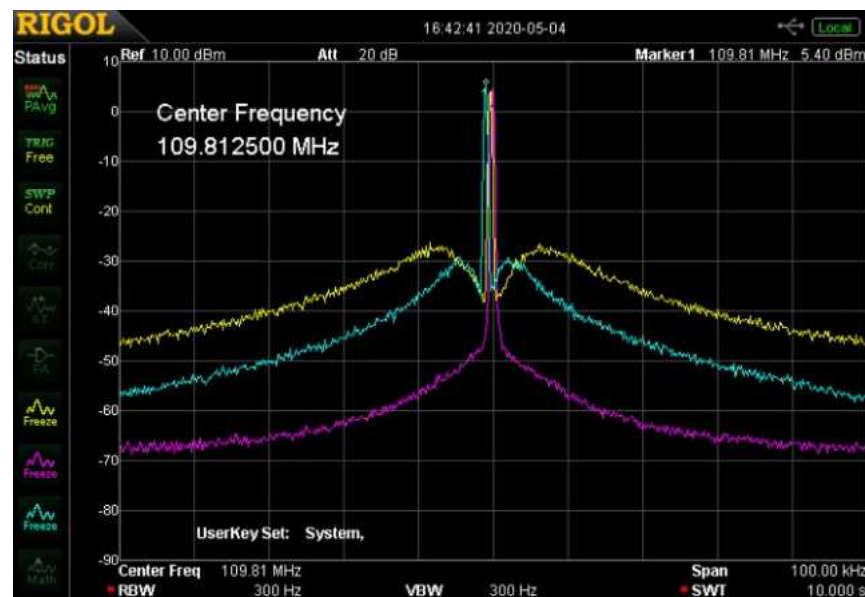
When they were used as a crystal replacement in Tom's 70cm, ATV transmitter, they created various undesirable artifacts in the resultant TV picture. The SG-8003 caused horizontal tearing. The SG-8101 caused background white noise, thus a P3 picture. The least objectionable was the SG-8002, but it still introduced some residual noise in the TV image, resulting in a P4 picture. The TV picture using the 510CBA was P5 and identical to using a crystal in the oscillator.

The result is our conclusion that the Silicon Labs 510CBA, PXO can work as a suitable replacement crystal in PC Electronics, AM-TV transmitters. Thus, KH6HTV VIDEO has agreed to help Tom by building and selling these to ATV hams for their PCE transmitters at a price of \$20 each, including postage.

Fig. 4 Shows a typical crystal and the new KH6HTV Video PXO replacement using the Silicon Logic 510, PXO. Fig. 5 is the schematic diagram.

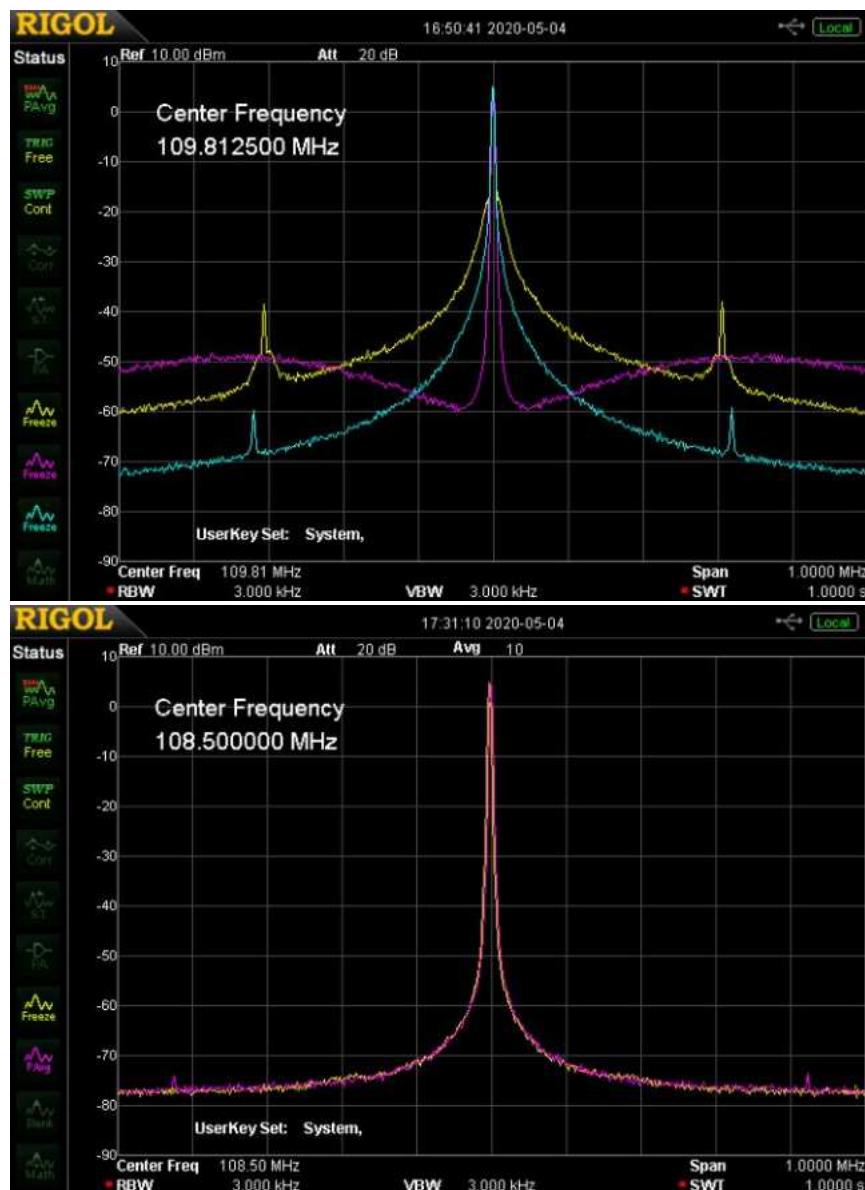
The SL 510, PXO, U2, is a CMOS circuit requiring +3.3Vdc. U1 is the 3.3V voltage regulator. This PXO is intended to be directly plugged into an existing crystal socket in a crystal oscillator circuit. The PXO pc board is provided with 0.04" dia. pins to match those of an HC-50/U crystal package. All connections on the board are labeled. Care must however be exercised as one pin is a DC ground pin and it must be plugged into the appropriate pin in the oscillator circuit. Another requirement is that DC power must be supplied to the PXO.

A solder pad is provided on the top right hand corner. Fig. 4 shows a DC power wire attached to this pad. DC voltages from +8 to +15Vdc may be applied. There is another solder tab labeled as OE, for Output Enable. This is a logic input to U2. Normally it is not used and is left open. U2 has an internal, pull-up resistor on OE.

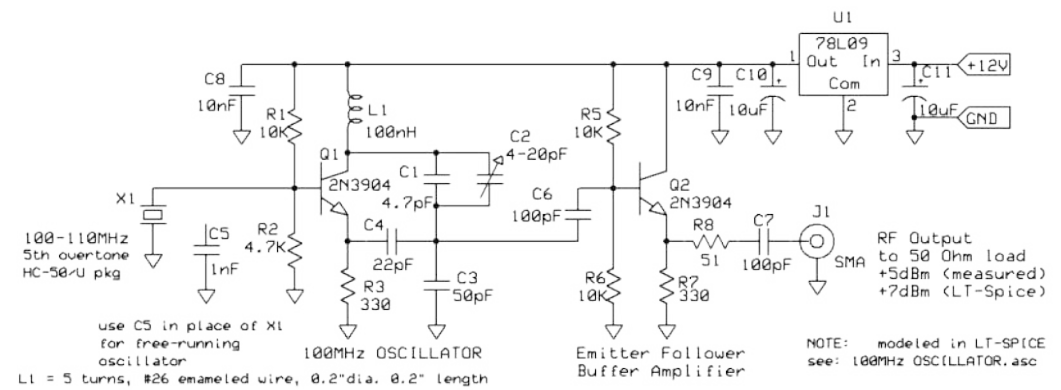


**Fig. 1 Close in  $\pm 50$  kHz Phase noise of various oscillators:  
10dB/div, 10kHz/div, 300 Hz bandwidth.  
top photo: yellow = SG-8003, magenta = SG-8101, cyan = SG-8002 PXOs  
bottom photo: yellow = HC-50/U crystal, magenta = 510CBA PXO**

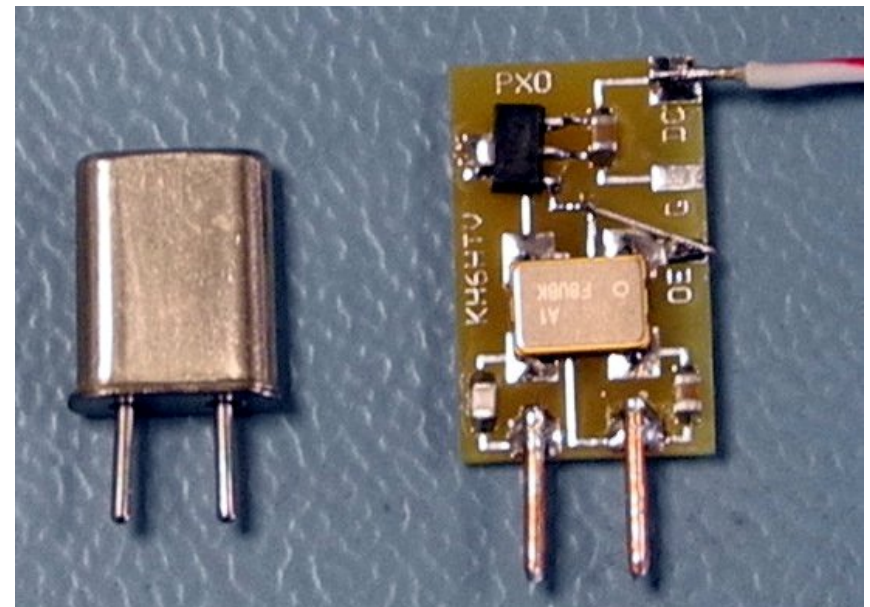




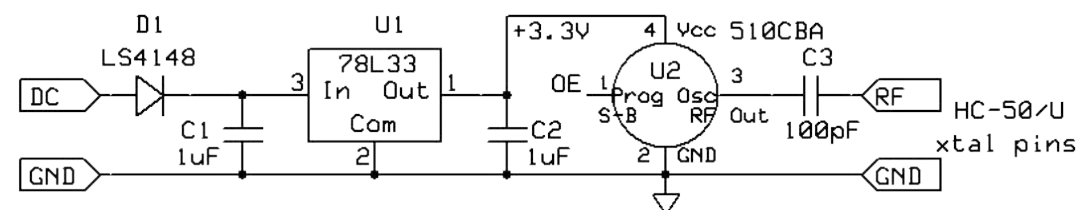
**Fig. 2 Wide-band,  $\pm 500$  kHz, Phase noise of various oscillators:**  
 10dB/div, 100kHz/div, 3 kHz Bandwidth  
 top photo: yellow = SG-8003, magenta = SG-8101, cyan = SG-8002 PXOs  
 bottom photo: yellow = HC-50/U crystal, magenta = 510CBA PXO



**Fig. 3 100 MHz Overtone Crystal Oscillator, Test oscillator for crystals and PXOs**



**Fig. 4 an HC-50/U crystal and it's PXO replacement**



**Fig. 5 KH6HTV Video PXO schematic**

## Baofeng GT-3TP Review

Written by John Hudson G3RFL



While under lockdown I thought I would evaluate my latest purchase the Baofeng GT-3TP transceiver is that's the right word or perhaps walkie talkie is the correct term I don't know where the crossover point is as we are able to pack so much into a such a small space these days, the line between the two technologies might be in need of being redrawn.

It is true it is hand-held, so let us go with that it, is also multi band 2m and 70 CMS but will also cover FM radio, Aircraft and Marine, channels. As sold the unit is CE marked so is complies with Uk rules and is FCC marked too. Not being in possession of a Maritime VHF license or its Aeronautical equivalent I did not explore if it could be programmed to transmit in these bands. The rules are different to amateur radio, EG Maritime Channel 0 is reserved for the coast guard and RNLI and should not be available on CE kit unless you are a member of the Auxiliary Coast Guard and as such have permission to use channel 0.

I know Trevor has a Maritime VHF license so if you want that side reviewing you know who to ask.

Problem 1 is the very small handbook, they always say read the small print, well I have to say that is a problem, but I found an online version, so I can report I have read the small print or at least its large print big brother version.

Problem 2 who ever wrote the book did not have English as their first language, I suspect it comes along way down the list, or it's a computer language conversion, we may have all wrestled with one of these at one time or another.

The menus are the usual multi-language and in order to find the one you want in my case English you have to understand the start up language, but now much the wiser I can reveal Option 14 is language then 1 is English 2 is Chinese 3 is none. The Unit comes with an external mic/earpiece, a battery charging cradle and a whip aerial.

A lead to charge the internal battery from a car cigar lighter (why do they always call them that it conjures up vision of Winston Churchill) and a mains wall wart power supply, you know the kind that does not fit a UK plug socket, like most electric shaver use.

Everyone has an adapter somewhere in the house, unless they have stopped shaving or use the barber of Savile kit and a leather strap to sharpen it. A belt fixing clip and strap that I thought well worth the money.

It has three power settings of 1, 4 and 8 watts, not bad for a hand-held.

My first port of call was You-Tube and there is a particularly helpful video there and I have added the link at the end of the article, so you can click watch and learn.





## BAOFENG

### GT-3TP Mark III Combo

awaiting delivery, but so far have had two handheld to handheld QSO's on the unit.

Really impressed for an outlay of £30 I really love the unit and for £30 less than a good night in the pub (if only) it comes as highly recommended, with no hangovers either. My thanks to Bob to G1EPL who pointed me at the kit as way of passing lockdown and diverting my funds that might have been squandered at the local hostelry.

This YouTube video gives a GT-3TP Baofeng 8 watt review, test and programming.

<https://www.youtube.com/watch?v=4TyZdFbI4jw>

The only pitfall is the cradle and cigar charger, they are for battery charging only, this is specified on the cradle, but again in small print. There is built in voltage regulation to compensate for car batteries which can deliver anything from 12v to 15v. This does not supply the demand of the unit being used and must be disconnected if you want to use the unit, otherwise the purchase of a car fire extinguisher might be a useful accessory.

The unit 's channels are all programmable with a programme called "Chirp" and it really is surprisingly friendly. Chirp does all this programming down the USB connector, the required lead does not come with the unit, I have ordered one and am



## Guidelines

The single rule for an article is that it must somehow be linked to ATV or one of its many derivatives, CCTV, repeaters, aerials/dishes etc.

Write your article in whichever software you choose. I would recommend LibreOffice (this is cross platform and free). But please spell and grammar-check it!

## Writing



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## Fade to Black

*First published in issue 1*

**Written by Trevor Brown**

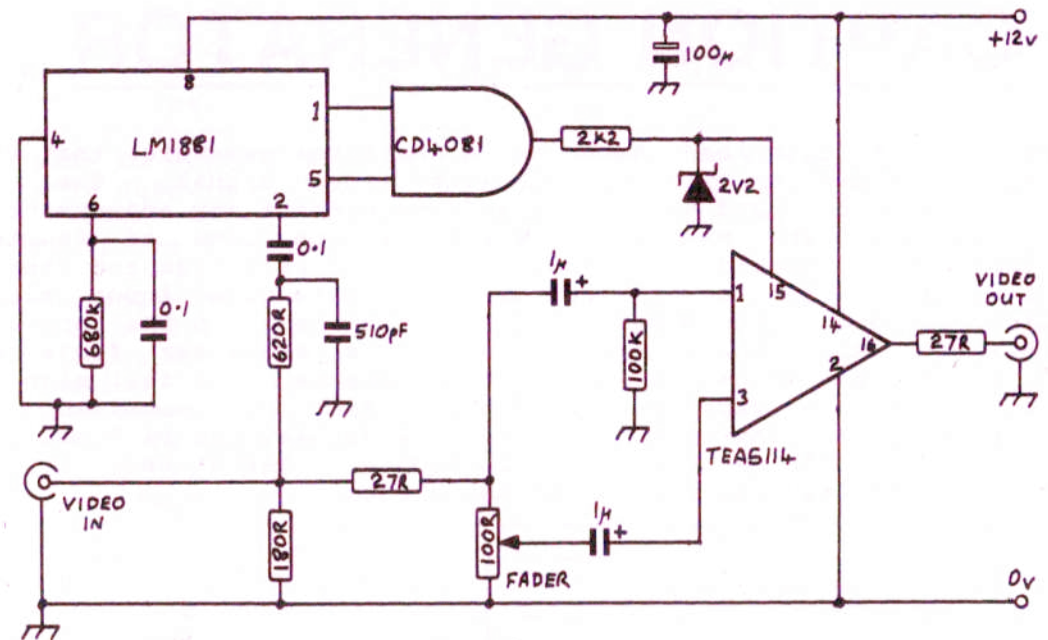
Seeing John's repeater logic and the TEA 5114 which he assures me are still available, but maybe only from his junk drawer reminds of me building a simple fade to black unit, using the same video switching chip, I think it only existed on a prototype board and several people have added improvements to the basic circuit over the years (see CQ-TV 160 and 157).

I remember burning the midnight oil on the unit because one of my neighbours needed to give a video presentation to a football club using of different sections of several VHS tapes. These clips needed editing together onto a single tape so they could be part of a presentation.

This would have been easy on a modern NLE editor, but this was back in 1989 when things were not quite what they are today, the unit was built alongside an audio fader unit, yes you have guessed it, a single pot.

I spliced the unit into a SCART lead so it could be used to connect two VHS machines and enable, fading up and fading down, when transferring material.

This helped isolate the required sections when copying between the two machines. Couple this with a the pause edit that always look terrible on VHS machines, but if you faded to black and then paused, cued up the player released the pause and faded up, well it looked passable.



It worked by using the TEA 5114 as a dual input switcher, both paths being connected to the same input source, but one via a 100 ohm fader. The switch takes the fader input in active picture, but in blanking it takes the non fader path. So you can only fade active picture not syncs and colour burst.

Not sure on the availability of the chips, but once you understand the principle, better sync separators and more modern vision switching chip are on the market.

Although I hope you never come home from work to a note and two VHS tapes that needed the above work at very little notice.



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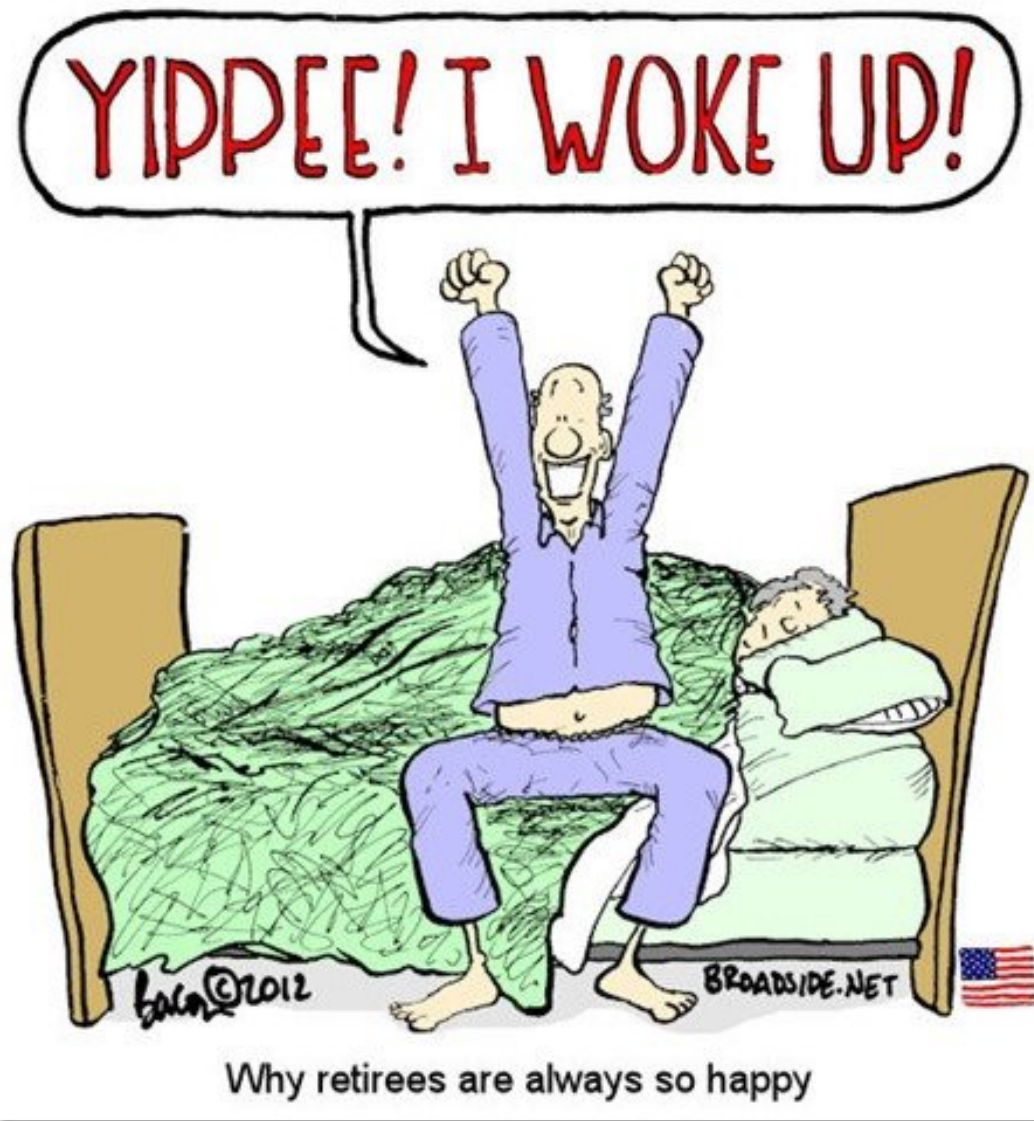
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