In this issue

Production Team

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Contributing Authors

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Editorial

Welcome to CQ-DATV 69, which has all the usual news and mix of TV related articles.

In this issue, Trevor has written another instalment of his series following the development of VTR. In this issue Trevor has moved on from C format to component recording and its introduction in the news world with ENG (Electronic News Gathering).

Jim Andrews, KH6HTV explains how the Amateur Radio Emergency Services, or ARES to give it its sponsored name, works and in particular the Boulder County group called BCARES.

Most satellite receivers and set top boxes have a function to display a signal report obtained by sequences of key strokes from a Hand Remote. Peter Cossins VK3BFG, describes a process where a Master Controller responds to a DTMF code and sends an ASCII Character to an IR Emulator circuit to replicate this function.

Mike Stevens G7GTN has been engineering a full custom control panel to use with the VMIX production & switching software. There will be a follow up article which will add source code, so we can all create a bespoke panel.

While on the subject of control panels, Trevor has started looking at the inner workings of his Grass Valley mixer control panel. He has removed the custom micro and put together an I2c interface so the panel can be controlled by a different choice of micro. Trevor has used the ESP 8266, flashed with BASIC and has started by mapping out and controlling the panel lights. The I2c bus opens the door to control by almost any modern micro and not necessarily one running BASIC, although as Trevor comments it is starting to grow on him.

One from the Vault looks back at a Simple Preamplifier for DATV. This first appeared in CQ-DATV 5 published in September 2013 and designed by Richard Carden VK4XRL, have we really been going that long? Yes, but actually longer and it's why we have added an electronic index to the CQ-DATV library so you can easily search for any of our back articles.

As we always say, sit back and enjoy CQ-DATV 69.

CQ-DATV Production Team

TV Amateur is a German Language ATV Magazine. It is published 4 times a year and if you would like to subscribe go to ***http://agaf-ev.org/***

News and World Round-up

Progress report from Bryan- KC8LMI on their DVB-T experiments in Michigan.

Hi Guys,

Just wanted to share some pics and info on the dvb-t testing dad and I got to test last weekend. The pics are taken thru the repeater which is still on analog 900 out.

His setup is a pair of par omni angle antennas, 15ft lmr-400, modified Comark amp running 40 watts, hi-des exciter, with home made ipa to drive Comark, dual 12v Astron power supplies in series, a wireless switch to turn ac power on and off from inside the cab, and a small generator in the back of the truck to power the whole setup.

The first pic is of Mason water tower at 21.7 miles north of the repeater site. He was able to pull over and I took the pic.

The Meijer logo is 22.0 miles north and just down the road from Mason water tower.
image

The 4th pic showing the dash is at 20 miles to the east from Chelsea.

And today I was tripping it at 17 miles s.e. with my 2 stacked wheels and 4 watts mobile in between Chelsea and Manchester.

So far our testing has been pretty impressive. While in motion isn't very good, lots of freezing but the receiver seems to recover fairly good from this. I will eventually setup a small mast on the hitch and have a beam to switch to once I can park to do better stationary testing.

We are looking into options for streaming both the analog and digital inputs, I will update once we have a solution.

73, Bryan

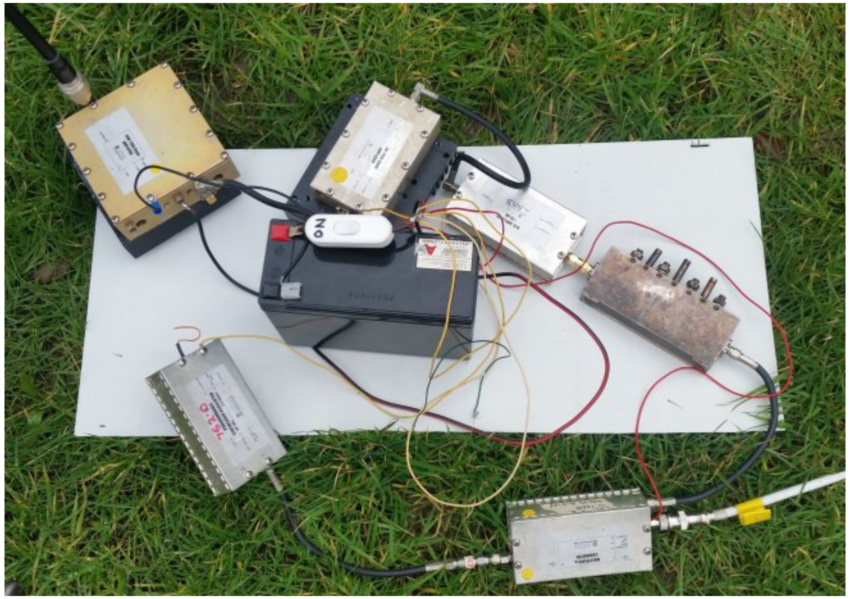
Dave Woodhall reports on Eshail NB

Just had 5 SSB QSO's on the satellite, Italy, Holland, Germany and two UK.

My TX puts out about 1.5w to a plate antenna about 18dbi.

My signal is about 15db above the transponder noise floor, so not bad at all!

My transverter is made up from old modules used in a 2.7GHz AM video transmitter.



The white coax is a 2m input to a mixer fed with a 752MHz LO multiplied x 3.

From there it goes to a interdigital filter then a 30db MMIC amplifier, then a driver putting out about 600mW, then a PA giving 2w saturated output.

Moving on from C format

Written by Trevor Brown G8CJS

In CQ-DATV 66 I covered the introduction of C format VTR that replaced Quad format. It delivered slow motion, portable field recording, and serial interface to some very impressive video editing controllers.

This was a door that changed the way TV programmes were made. It allowed full post production access to studio recordings, which in quad days had with some exceptions been limited to stitching scenes together, it pushed out film in some domains, in ITV all the centrally bought programmes were stored and dispatched as film with the option of tape if available.

Film was arduous and slow to edit, if a programme used inappropriate language then mechanical caps were put on the audio track and the well mouthed obscenity was seen and not heard. C format changed that and tape became the requested medium, which could be edited in house to suite the various broadcast code restrictions placed on it by the transmission time slot.

The Broadcast world was changing and Sony were a major player, so what did they cook up next. They looked at news which was still traditionally film based, with live studio links. Could film be replaced by video tape? First came the name for this process and the name was ENG (Electronic News Gathering).

The first attempt was to update an existing industrial machine, the Sony U matic. This had a good reputation and was the staple diet of airline in flight movies along with corporate users. They added the bells and whistles and in some countries it took off. In the UK it failed the quality threshold, so they produced Sony Hi Band.

Let me explain, these machines were colour under, the colour subcarrier was removed from the video and heterodyned down to a much lower frequency for recording which limited its bandwidth. In an attempt to improve picture quality Sony increased the frequency of the colour under subcarrier, it improved the quality and maintained monochrome compatibility between hi band and low band machines.

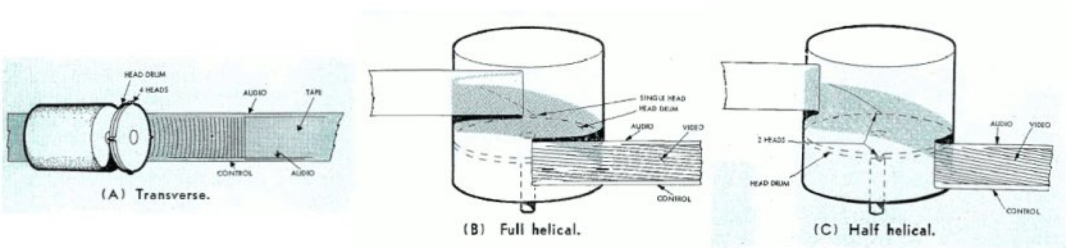
Sony Betacam - note the way the shoulder mount can be snapped onto a Tripod, a feature retained by all the range SP to Digibeta as was the B4 lens mount

They sold but mainly on the promise of Betacam, buy Betacam now, get a loan hi band U matic and when the machines become available we will replace them with Betacam.

What was good about Betacam.

Well it was cassette based as was the Hi band U-matic, it was component and would pass the quality threshold that colour under using FM subcarriers never could.

Also it would be incorporated into a Camcorder, just like film but with better editing and no film processing costs or the inevitable delays that film processing inflicted on an industry known for tight deadlines. The TV industry bought in and ENG was born. Sony had made a lot of promises and the pressure was on to deliver. The news departments were on a roll, late deadlines, flexible editing and Camcorders were on the horizon. Sony having delivered C format had the credibility to deliver ENG.



(A) Transverse. (B) Full helical. (C) Half helical.

The format was interesting. Cassettes need to use 180° wrap (half helical) to auto thread so they became dual head, one head joining the tape when the other left. This was not new, Ampex had a 180° wrap machine the VR660 back in the 2" days, many of the Moon landings were recorded that way. Sony had used it for U matic and it was a proven method, so it was revisited, but with half inch tape cassettes.

VR 660 Ampex's Half Helical VTR from the 60's

So exit Reel to Reel machines, they died with C format, despite the auto thread of the BVH 3100.

The problem was delivering component recording and FM subcarriers were not going to deliver so they came up with a video dual track machine one for the chroma and one for the colour, FM but no subcarriers.

These meant that they had somehow to get the three colour channels onto this additional track and they came up with CTDM (Component Time Domain Multiplexing).

They never went RGB but U and V so they needed to get two colour signals down one track. This was achieved by clocking the U and V into shift registers and clocking it out at twice the speed. This doubles the bandwidth, but compresses the length of the signal so that two signals can occupy the same track.

Did it work? Well yes and no! Betacam machines were delivered and replaced the Hi Band U matics, but there were problems, aliasing being one, often referred to as the parrot in the cage, the bars have edges that obscure the parrot, The News departments used them, but Sony needed to do some work and they did.

The cassettes were kept, but the tape was changed to metal tape and a lot of re-engineering took place inside the machines with comb filter being the order of the day to deal with separating the chroma from the luminance signal.

The new machine was called Betacam SP and was undoubtedly a success, Sony had delivered component recording which opened many doors including Colour Grading so pictures could be graded in post production and chroma Key was possible on VTR replay.

The format did not stop there, the same cassette was used for a digital version (Digi Beta) which was loved by TV production and was not limited to news programmes.

The camcorder was here to stay and developed, Betacam, became Betacam SP and then Digi Beta which was used for a lot more than news and is still the staple diet for many documentary and life style programmes, where film cost were beyond budget and reserved for drama production, but even here Digi Beta has made inroads.

Don’t get the impression Sony were the only players.

A Modern Digi Beta Camcorder

Panasonic AU 750 machine, a rival component machine to Beta SP (note the PPM sound monitor meters) These machines are often to be found on the second hand market at very reasonable prices, but check the pinch rollers before you buy one

Panasonic added a Component cassette machine format the MII, which also had a camera and dockable VTR, there were problems the pinch rollers reacted with video tape and melted and replacements were sought, these were otherwise a very professional VTR, but if you buy a second hand one check the pinch roller.

Bosch announced a quarter cam, presumably a reference to the tape size, but alas I don’t think it got launched into the market place. Component recording was a giant leap, tape copying still caused quality loss as the generations took their toll, but nowhere near as bad as composite, but then digital was not too far away and the clever move of Read before Write, which opened even more doors also wide screen television was on its way. Yes we went digital and finally left FM behind, it had served us well.

To be continued........

TV in ARES

Written by Jim Andrews, KH6HTV

Fig. 1 BCARES live video feed from mountain top to 911 Emergency Operations Center. Shown is a slurry bomber fighting the Four Mile Canyon forest fire in 2010.

This is a TV success story for a local ARES group.

In the USA, we have the Amateur Radio Emergency Services, or ARES. It is sponsored by the national amateur radio organization, ARRL, but operates on the local level. The Boulder County, Colorado ARES group is called BCARES for short. BCARES has experienced a lot of success working with our county's emergency services organizations, in particular, fire and law enforcement.

BCARES's tool kit includes all of the ordinary ham services, including HF/VHF/UHF voice communications, repeaters and various digital modes on HF plus packet on VHF/UHF with back-bone linked digipeaters.

What Boulder County Public Safety lacked most and BCARES had to offer was — TELEVISION. Amateur television is the one BCARES capability that really excites our served public safety agencies.

BCARES started offering TV services about 30 years ago. We added TV at the encouragement of Captain Bill McCaa, K0RZ, of the Boulder County Sheriff. Bill was in charge of all of the Sheriff's communications and computer operations and the county regional 911, emergency radio dispatch center. Since then, BCARES has received many more requests for assistance using TV than for all other communication modes combined.

Fig. 2 Night time, BCARES, video image transmitted to Incident Command Post. A forest fire on the mountain immediately adjacent to the City of Boulder

TV offers “Public Safety” information in ways never imagined by us or our served agencies. Television has come to be appreciated by our served public safety agencies because it provides what they refer to as “situational awareness”. It helps remove the need for many voice communication exchanges for information that is already contained in the video imagery.

Television allows the incident commander at the Incident Command Post (ICP) to actually see what is happening at the scene(s) of the incident. With this video information, the incident commander is better able to make appropriate command decisions.

Via our 2 meter, TV net controller, the Incident Commander is able to request BCARES cameras to provide him with specific images and information. BCARES is able to routinely provide television and all of its other communication services in a completely infrastructure free manner.

Many times every year, BCARES has been asked by our local law enforcement and fire departments to provide TV coverage of both real emergencies and also multi-agency training exercises.These have included situations such as large, multi-agency forest fires, flash floods, hazardous materials incidents, civil disturbances, large political demonstrations and protests, University of Colorado football games and SWAT operations.

Note: SWAT in the USA stands for Special Weapons And Tactics. It is a paramilitary unit within the police force which handles the most extreme, dangerous situations using heavy weapons and armor.

Boulder County ranks as the leading flash flood threat zone in the state of Colorado and BCARES is specifically written into County emergency planning.

BCARES’ most shining moment occurred in September, 2010 when the worst forest fire in Colorado history broke out in Boulder County. The Four Mile Canyon fire burned over 6,400 acres of forest and destroyed 166 homes. BCARES assisted firefighters providing live TV coverage from mountain tops back to the 911 center for an entire week. At the end BCARES was credited by the Sheriff with saving several homes.

Boulder County covers an area of 740 sq. miles, with the eastern half being flat prairie at 1 mile elevation and the western half being the Rocky Mountains reaching heights over 14,000 ft. It is part of the Denver metropolitan area with the county’s population being about 1/3 million, most of whom live on the eastern prairie part of the county. There is a national forest and national park in the western half. The two major cities in the county are Boulder and Longmont. The large University of Colorado (CU) is located in the city of Boulder.

Fig. 3 The BCARES portable Quad TV Receiver box. Older analog unit. Included 4, 70cm, CATV receivers, 23cm FM-TV receiver and 2 meter FM transceiver.

BCARES was organized and incorporated by Boulder County and the local ham clubs, in 1977 after the disastrous, 1976 Big Thompson Canyon flash flood which claimed 144 lives. The official office of BCARES is in the Boulder County, Office of Emergency Management (OEM), in the county 911 center. BCARES is recognized by the OEM as being both the ARES and RACES organization for the county.

BCARES presently has about 80 active members. Every member is required to be approved by the Boulder Sheriff after a thorough back-ground check. After receiving training and upon approval by the Sheriff, each member is issued a formal Sheriff's department photo identification card. Four volunteer BCARES members are also on the Sheriff's SWAT team and respond automatically with the SWAT team whenever it is paged out for an operation.

BCARES is funded by contributions from FEMA, served agencies, private and corporate donations, plus annual dues from the members. The Sheriff allows BCARES to use several of its remote radio sites and microwave links for repeaters. The Sheriff and OEM also provides BCARES with an operating position in the county 911 dispatch center along with a storage room for use as an equipment cache with 24/7 access.

Equipment in the cache includes a complete portable HF station with PACTOR III capability, multiple 2 m packet stations, backpack 70 cm TV transmitters and portable 70 cm TV repeater. Equipment caches are also maintained at the University of Colorado police dept. and the Longmont police dept. The only personal equipment requirement for BCARES members is that they own a synthesized, 2 meter, hand-held radio.

About twenty Boulder County hams actually have their own home, ham TV stations and are very active participants in a weekly ATV net using the Boulder ATV/DTV repeater [1].

Out of the 80+ BCARES members, about one half are TV trained and capable of operating the BCARES TV equipment. With the exception of the weekly TV net, there is little routine ham TV activity in the county. However, when there is a BCARES operation going, there may be as many as four or five TV channels light up and become active simultaneously on the 70 cm and 23 cm ham bands.

The period from 1990 to 2013 was the analog TV days for BCARES. Most all of the activity was on the 70cm band using NTSC, vestigial upper-side-band (VUSB-TV) transmitters. To be able to use all four available 70cm, TV channels (Ch 57-60), it was mandatory VUSB-TV be used. The TV transmitters from that era were mostly crystal controlled, AM-TV transmitters from PC Electronics [2] along with an inter-digital, 6 MHz bandwidth, channel filter.

BCARES also occasionally used FM-TV on the 33cm, 23cm and 13cm bands, mainly as point-to-point links. BCARES also had a portable, quad-receiver box, Fig. 3, which was taken into the field to the incident command post. This contained four, 70cm, VUSB-TV receivers. They were very high quality de-modulators made by Macom for use in CATV head-ends.

The composite video from these were then combined in a quad-processor for display as 4 in 1 on a single video monitor. A similar quad-receiver was also permanently installed in the county EOC & 911 center. BCARES also had a portable 70cm, 10 watt, in-band TV repeater (Ch 60 in & Ch 57 out).

In 2014, we discovered DVB-T and the fine DVB-T equipment built by Hi-Des in Taiwan [3]. BCARES has been providing since 1995, TV coverage for crowd security for the University of Colorado Police Dept. at the football games (50,000 capacity stadium). At the first football game of the fall 2014 season, a demonstration was made to the CU Police Chief of DVB-T.

Fig.4 BCARES TV Video Net Control in the CU Police Chief's command post at a CU football game. Dave, KI0HG, and Mark, KB0LRS, using the quad TV receiver box. BCARES had four, portable TV camera crews around the stadium transmitting simultaneously on the 70cm channels (57-60)

He was blown away by the dramatic increase in quality of the video images. No more snow. No more ghosting. Perfect pictures, plus in 1080P high-definition! The chief immediately granted BCARES $10,000 to convert all of it's TV equipment over to hi-def DVB-T.

Today, BCARES now has four complete hi-definition cameras and 3 watt, 70cm, DVB-T transmitters packaged in back packs for portable operations.

BCARES also now has a hi-definition DVB-T quad receiver box for 70cm, plus a portable 70cm, in-band TV repeater.

Fig. 5 BCARES TV camera crews at a University of Colorado football game using DVB-T, digital TV transmitters. left to right: George, KA0BSA, Steve, WB0NFQ, Jim, KH6HTV, Ron, K2RAS and William, KD0YYY

Of the twenty or so Boulder ATV hams that have their own home stations, all but one of them are now using DVB-T, either on 70cm or 23cm bands, or both.

Many of these ATV hams are also members of BCARES and their TV equipment is also available for use in BCARES operations when even more transmitters are required.

For one, recent, 10K race, with 50,000 runners, BCARES was requested by the Dept. of Homeland Security to provide eight (8 !) seperate, simultaneous TV transmitters to cover the race. This required bringing in more personal TV equipment and was a major technical challenge to pull off.

When using TV for ARES operations, the same FCC rules and guidelines apply as for voice and data transmissions. Operators need to use common sense and decency along with the FCC rules to determine what are appropriate pictures to transmit. BCARES has turned down some requests for TV, typically for foot and bicycle races, when it was determined they were for commercial usage, rather than bonafide public safety purposes. As with any other ham transmissions, TV must also be identified at least every 10 minutes, per FCC rules.

For analog TV, we did this visually by holding up a small QSL type card in front of the TV camera lens. Because we are also usually transmitting audio along with the video, we also made a voice ID announcement simultaneously. Our analog TV repeaters did this automatically with Morse code and also color bar, call sign, video ID generators. Today, with modern digital TV transmitters, our IDing is done automatically for us with the built-in meta-data transmitted along with the video stream. We still also continue to do a voice and visual ID.

Television has proved to be very useful to the Boulder County police and fire agencies and as a result has gotten a lot more hams active in public service. There is nothing worse than having a group of dedicated ham ARES volunteers that never get called upon to serve. After awhile they lose interest. Then, when they are really needed, they are not there or maybe worse, they are untrained. With TV, that has happened far less to BCARES. BCARES gets called upon a lot. We recommend that other ARES groups consider adding TV to their "Tool Kits".

References:

[1] *http://www.kh6htv.com*

[2] *http://www.hamtv.com*

[3] *http://www.hides.com.tw*

Fig. 6 BCARES TV cameraman with Boulder Sheriff's SWAT team, using tear gas to disperse a crowd of rioting university students. Video transmitted back to command post

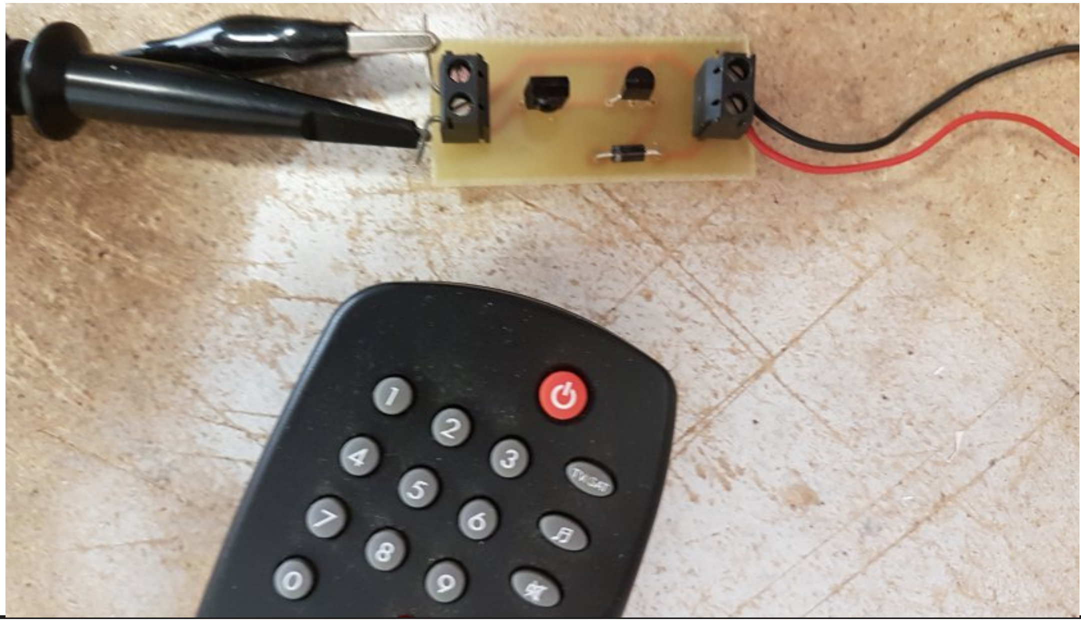
Remote Infra Red Controller for ATV Repeater

Peter Cossins VK3BFG

Most satellite receivers and set top boxes have a function to display a signal report obtained by sequences of key strokes from a Hand Remote. Mini Media Boxes that play MPEG files also are controlled by a similar sequence of similar key strokes.

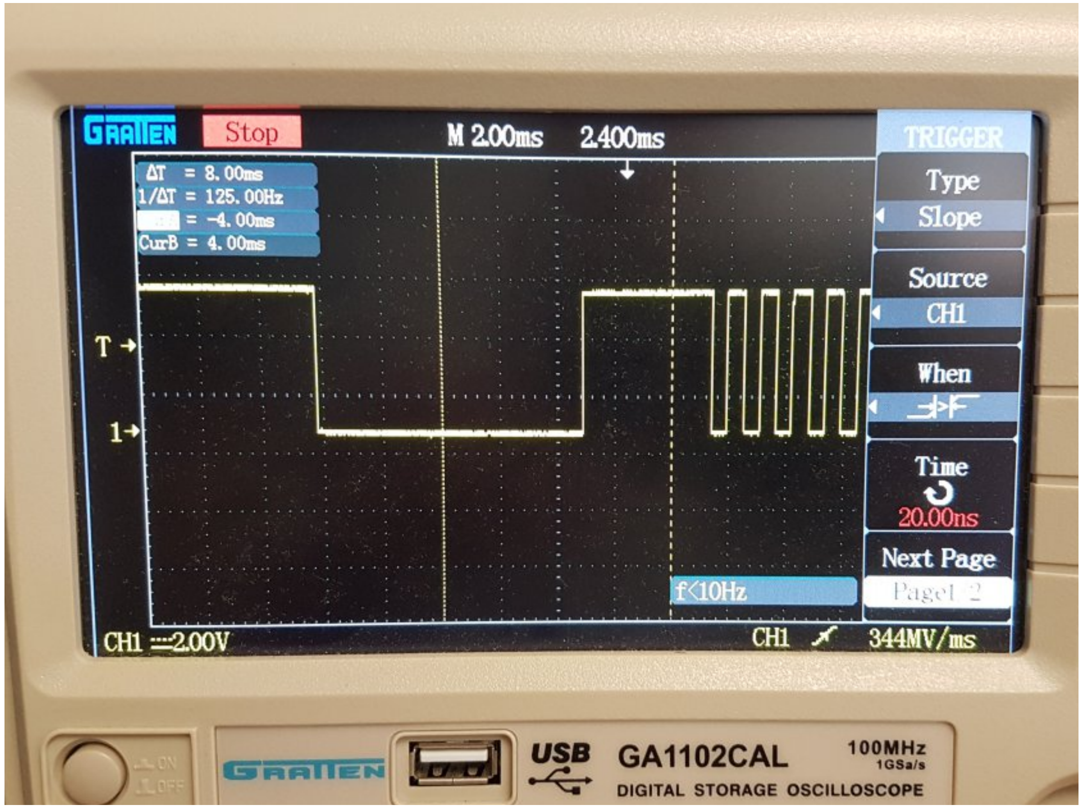
This short article describes a process where a Master Controller responds to a DTMF code and sends an ASCII Character to an IR Emulator circuit. This circuit then controls an IR LED placed close to the front of a receiver adjacent to its IR LED. (The same process can be used to remotely control a Mini Media Box.)

I used an IR receiver mounted on a small PCB to facilitate capture of key stroke codes for various functions. I found the following.



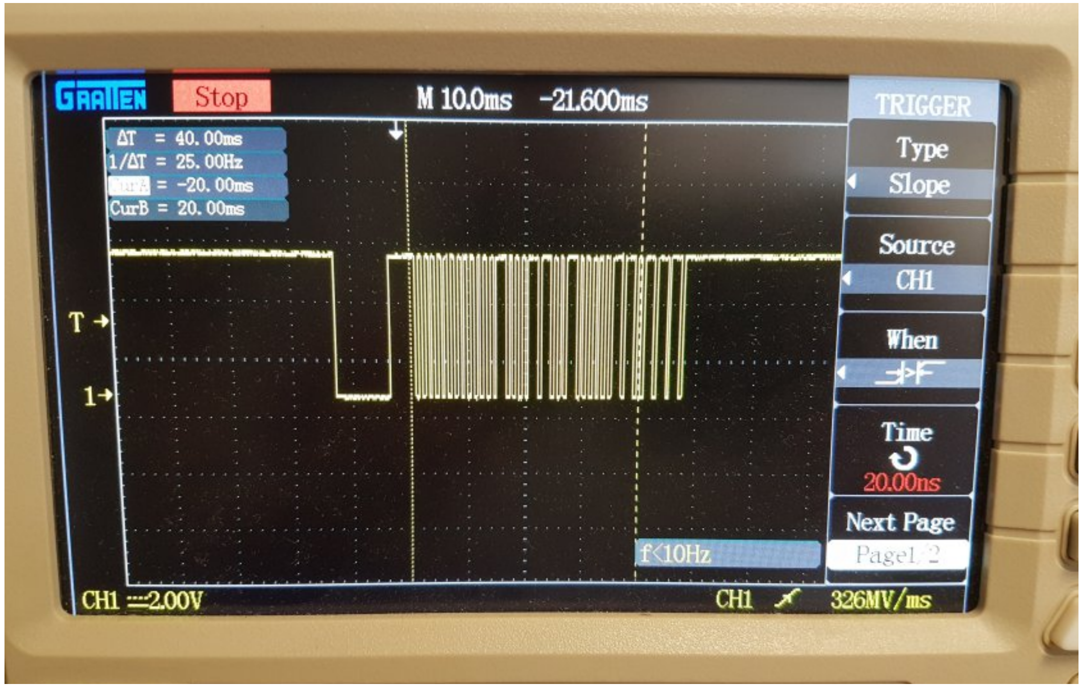
The start sequence from a hand remote comprises a 9 ms logic low pulse, followed by 4.6 ms pulse, logic high to low. The data follows and are logic high pulses based around 560 us which I called time 'T'. There can be data pulses of T, 2T and even 3T.The whole frame is around 108ms.

After some measurements using the capture function on a digital oscilloscope I found that all the remotes that I tested had a similar signature forming a digital word. This word had the same start sequence and subsequent structure, but with differing amounts and sequence of data.

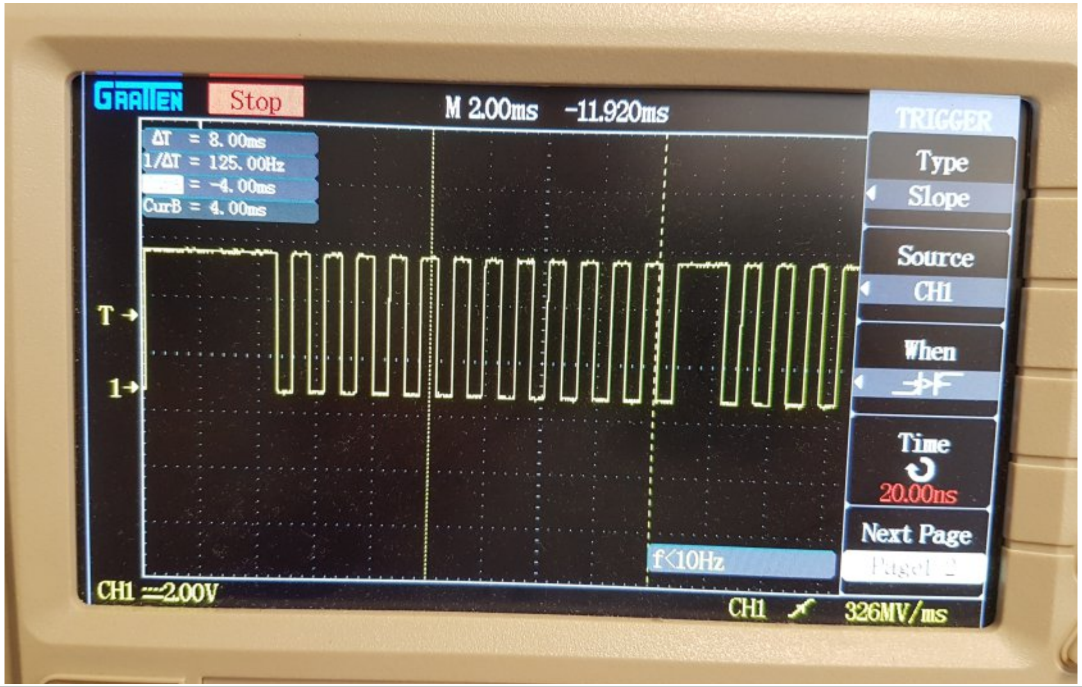


Above: 9ms and 4.6ms Start Pulses followed by the start of the Data Stream

Left: Infra Red Receiver Connection to CRO to establish Codes for Functions



Above: Whole Data Frame
Below: T (560us) and 2T (1.120ms) Data Pulses



The program in the IR Emulator responds to a single Ascii character send to it by a Master Controller. For example controlling a Humax IRCI-5400Z satellite receiver.
- M Menu
- K OK
- X Exit
- D Down key
- F On/Off

These functions allow the Master Controller to turn the receiver on and off (eg re-cycle) and access such functions as the signal report. Alternatively the process could be used to play a specific MPEG file on a Mini Media Box.

The Master Controller orchestrates the IR sequence required to access the signal report of the Humax Receiver or to play a track in the Mini Media Box by sending ASCII characters to the IR Emulator in the correct sequence.

It would be possible that the microprocessor in the IR Emulator does all the work responding to a DTMF command, but this circuit was designed as a small adjunct to much larger Master Controller's in this case, VK3RTV1 and VK3RTV2.

It would also be possible for a Master Controller to do all the work, although in the case of VK3RTV1 and VK3RTV2, the Master Controller's had limited memory and free ports available.

The circuit provided has dual independent channels. Channel 1 could respond to capital ASCII Characters while Channel 2 responds to lower case ASCII characters, for example. Thus the Emulator could control the Humax Receiver and also a Mini Media Box.

I can provide the Atmel 8056 assembler code for the controller although more modern controllers could be used, perhaps with higher level language based around the timing I have described.

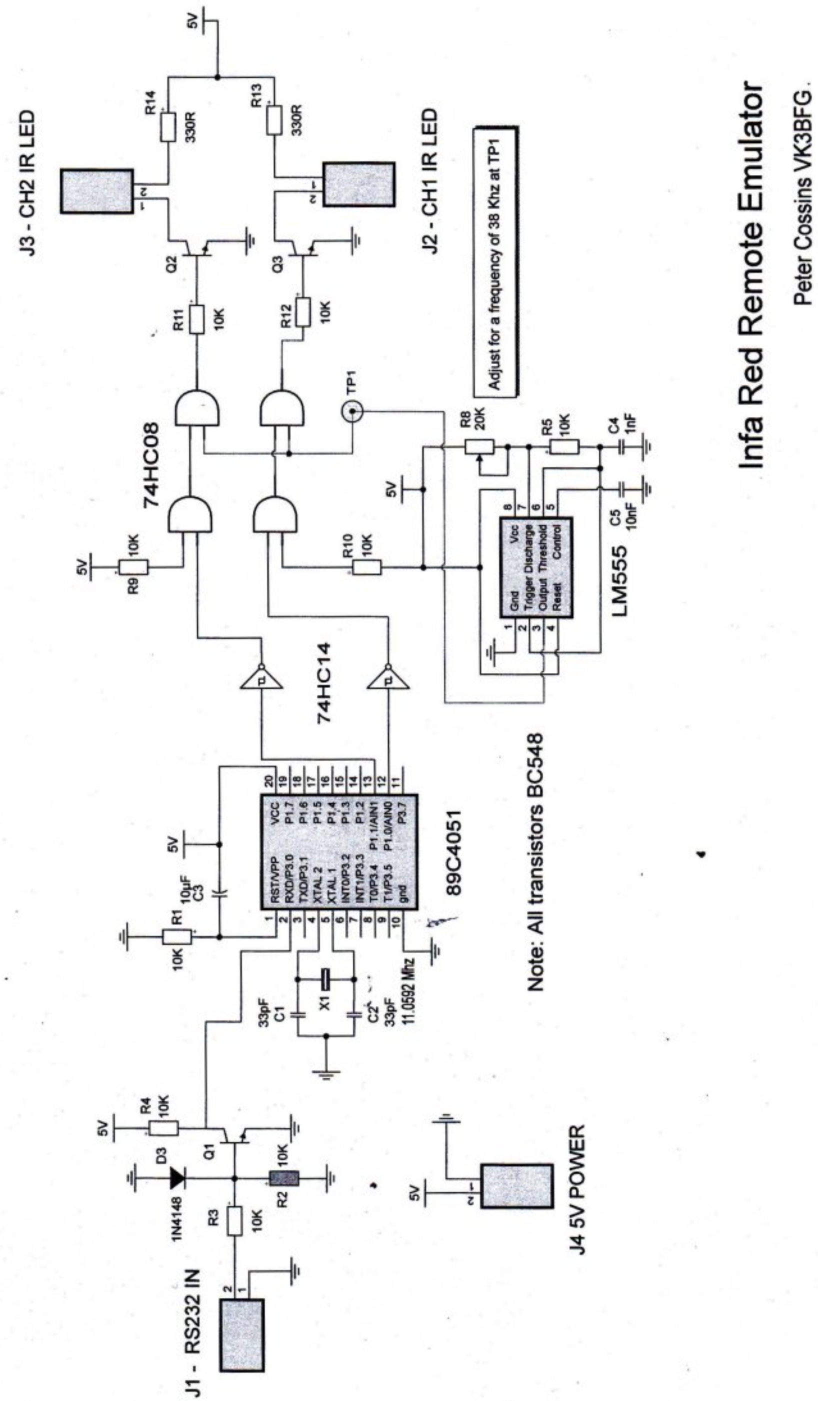
The existing software is for a Humax IRCI-5400Z Satellite Receiver and a Mini Media Box. I note that there are different versions of Media Box's.

Of course any more modern controller such as an Arduino could be pressed in to service instead of the old Atmel. You just have to generate the sequence of pulses required for a given function. The pulses are 9ms and 4.6ms for the start sequence followed by a number of pulses of T, 2T, and perhaps 3T where T = 560uS.

If you have access to a modern digital CRO, counting pulses for a key stroke is relatively easy.

The PCB layout available is slightly different to the circuit diagram, the PCB layout using PCB pins for connections and includes an on-board 7805. A software listing is available on request.

Peter Cossins VK3BFG *pcossins@bigpond.com*



Designing a VMIX Control Panel

Written by Mike Stevens G7GTN

Introduction

I wanted a custom control panel to use with the VMIX production & switching software, hence this project was born. There a quite a few references on the internet, the missing part being having source code to be able to make your own more custom creations.

Within the next few articles we will change that so the average constructor can easily follow along and build a nice custom panel at home. My prototype panel layout will be as depicted in Figure 2 as we already know we can make use of two main control methods, these being Ethernet on our local network and also MIDI.

In my implementation we will go the MIDI route and send custom commands back as an activator within our VMIX installation.

Basic hardware required

The processor module selected is the Ardunio MEGA 2560 for the amount of I/O ports available. This has to be a specific model of the board that makes use of an ATMEL 16U2 to do the serial UART functions.

Boards that have the more common CH340G devices can also be used (not my recommendation) but these require additional software to be running on your PC as a go between process before VMIX. Instead the 16U2 UART processor is custom programmed with a MIDI – USB converter firmware. This provides two less potential areas of trouble with our own control equipment.

ATMEL 16U2 Programming

To get the MIDI firmware on to the processor requires the use of an external programmer that attaches to the 6-pin header next to the device. The process is depicted in Figure 1 the required USB programmer is only a couple of pounds on places such as eBay.

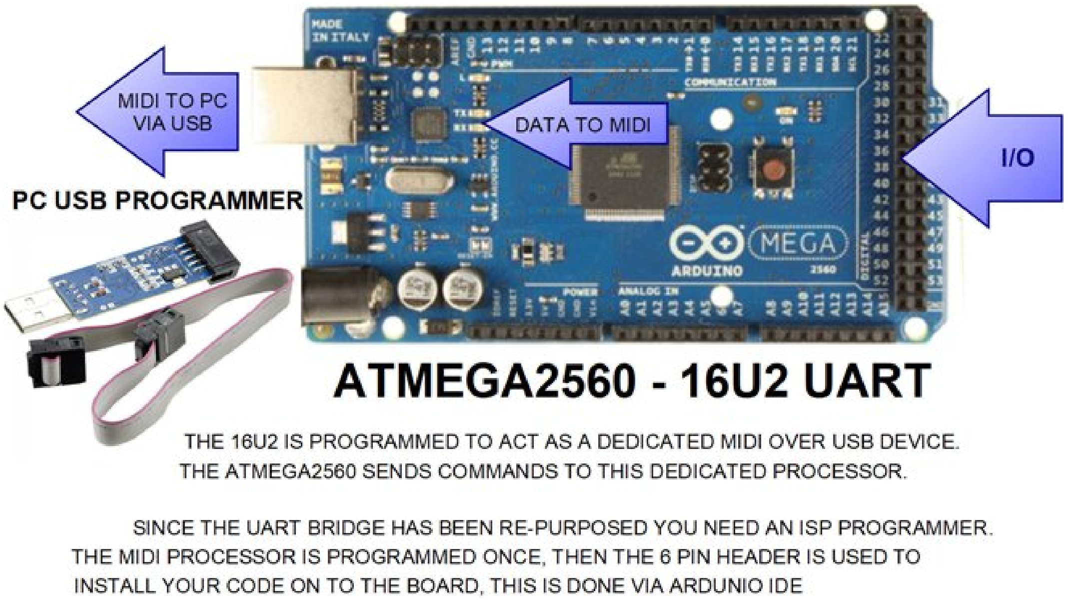


Figure 1 – General MIDI concept

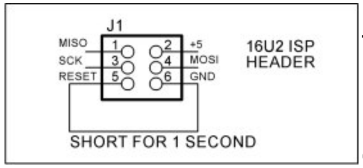
You need to download:-

https://www.microchip.com/developmenttools/ProductDetails/flip

this is the installer for the ATMEL DFU programming application called FLIP which is a 20MB installer.

Once you have this we require the custom MIDI Firmware hex file, this can be downloaded as a complete ZIP file from *https://github.com/ddiakopoulos/hiduino*

The file we require from this has already been pre-compiled for us. With your Ardunio Mega connected to your USB port load the file usbserial_mega_16u2.hex. You need to short out two pins on the 6 PIN ISP header to get the board in to upload mode. You can now proceed to get the MIDI bridge firmware programmed via the standard USB Connector.



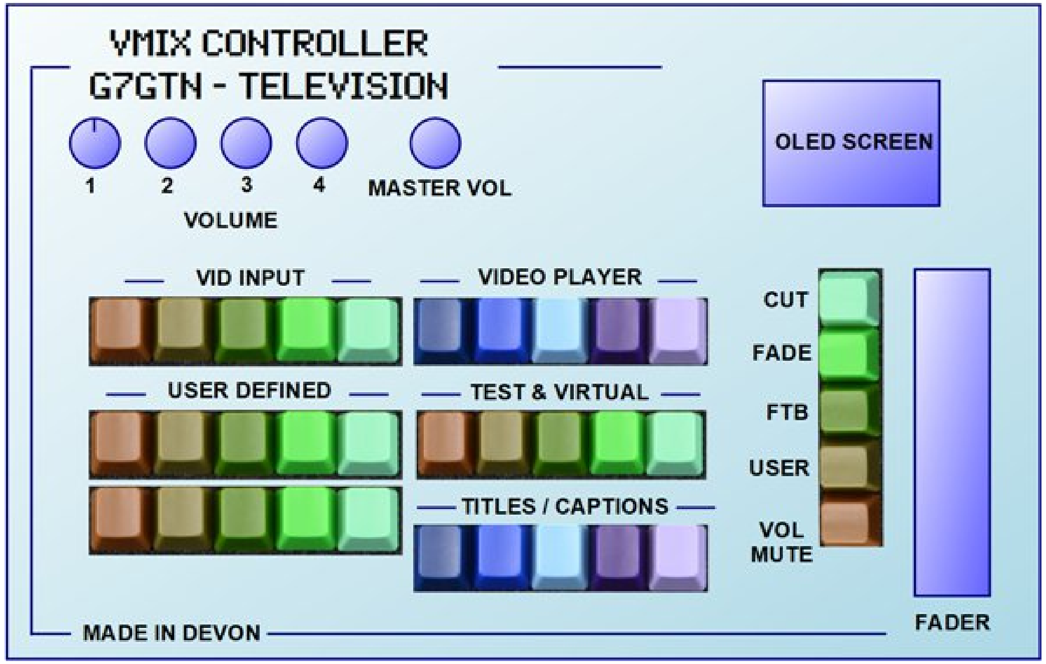


Figure 2 - Concept panel layout plan

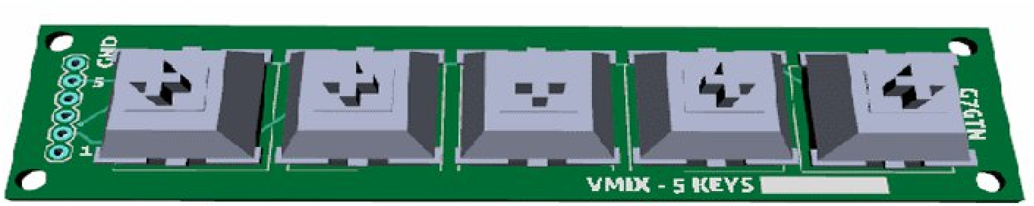
Installing the MIDI Library

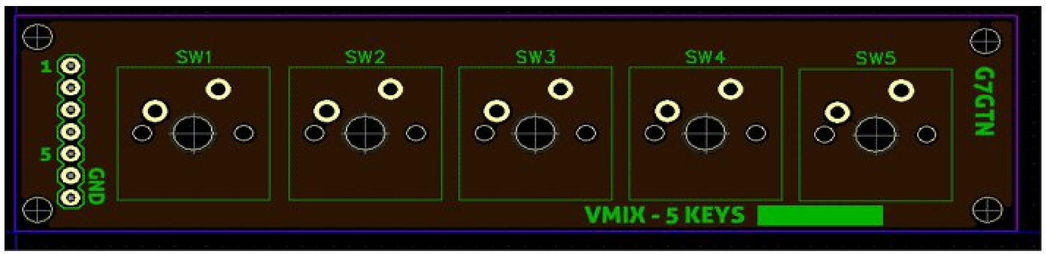
We require the installation of a custom MIDI control library, this is available from

https://github.com/tttapa/MIDI_controller/releases/latest

this is included as part of the test code. You need to install this in your standard Ardunio libraries folder. You should now restart the IDE after doing so.

Above: Console case waiting for modification
Below: Custom PCB for Cherry – MX Key Switches





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First simple MIDI Test

Now we have the firmware & library installed, I created the most basic test for this element. I connected a push button switch to digital I/O Pin 53 and ground.

The download includes a file called MIDITEST.INO which is loaded in to our Ardunio IDE. Whilst obvious, it is still worth a mention that we have lost the ability to now load code on to our board via serial UART. To install our custom code we move the programmer to the 6 pin in header (next to the ATMEGA2560) and select Upload using programmer from the Tools menu option.

A very handy MIDI debugging tool can be downloaded from *http://www.midiox.com/* to check we are receiving the correct messages. A screen capture of this process is depicted in Figure 3 this shows the hexadecimal value for musical note C0 on pressing our single push button switch. On pressing the button we get a Note On command, releasing it then gives us our Note Off command. Once we have our full complement of switches these individual commands will be mapped to functions within VMIX.

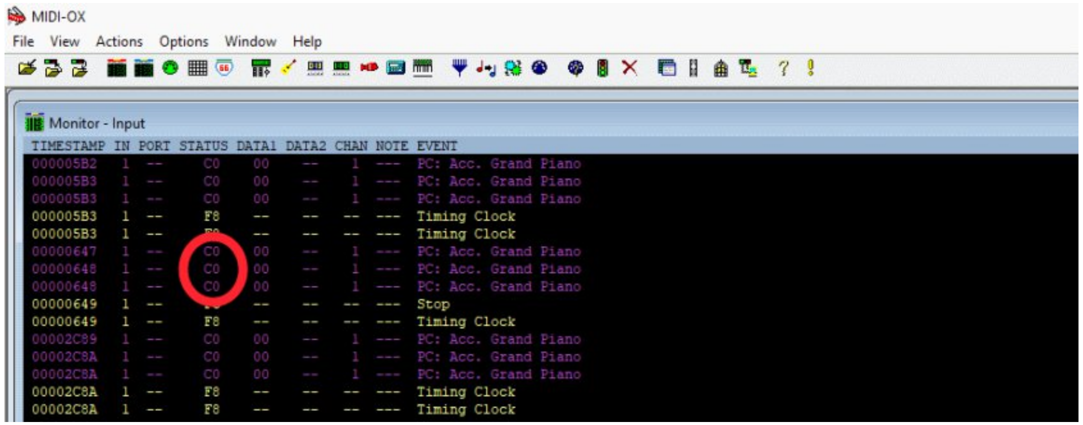


Figure 3 – Received MIDI data test dump

Parts Shopping

I have created a small list of parts that you can use as a quick guide when thinking about laying out your own panel.

The main electronic parts are the Ardunio Mega2560 with the ATMEL 16U2 UART bridge, be slightly cautious with this – make sure from the picture that you can identify the 6 pin male header nearest to the USB Connector. It seems these boards can be misadvertised and you will likely receive one with the much cheaper CH340G bridge device. My own board came from a UK supplier for £7.89.

The programmer is usually referred to as the USBASP type. An alternative AVR programmer is known as the USBTiny – these are both depicted in Figure 4 to help with correct identification.

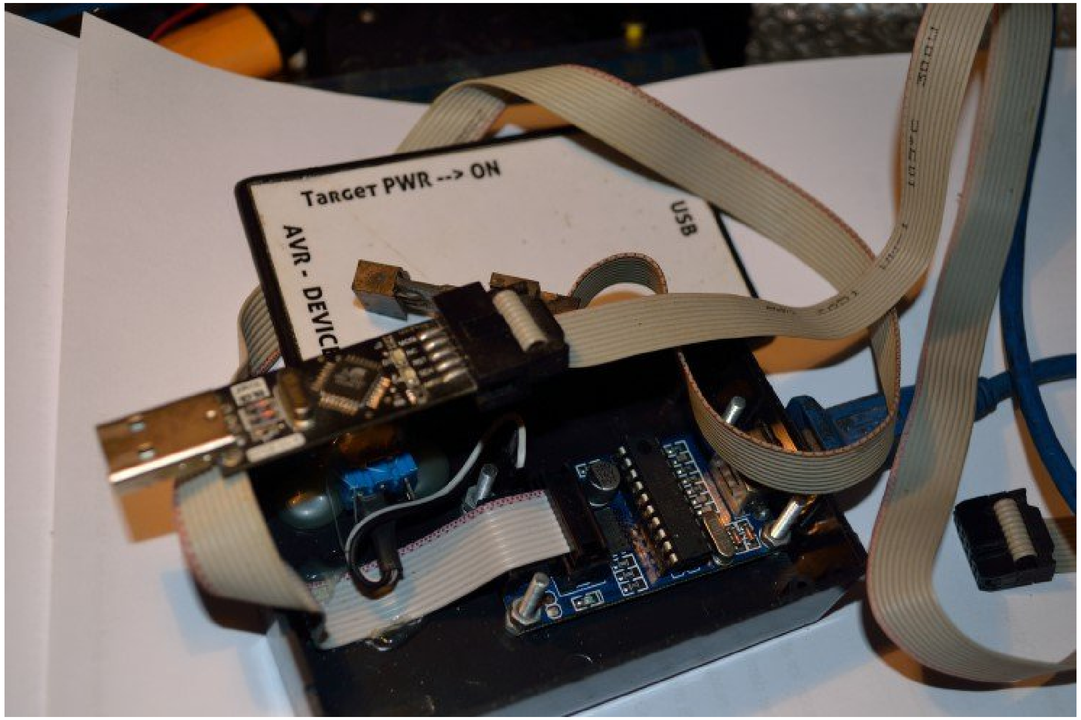


Figure 4 – USB ATMEL AVR Programmers

The switches I have selected are from the Cherry MX range, to make mounting them easier I have created a custom 5 way PCB. The key caps are dimensioned at 18X18mm, an old PC Keyboard might allow you to harvest some and then with a very small amount of work re-purpose these with new spray painted colours.

The PCB Diptrace generated Gerber files for manufacturing are supplied for your own usage as a download. My audio pots are all 10K Linear taper. The OLED module is an optional item you may wish to also include; this is (128X64) and controlled via the I2C bus.

Conclusion

I wanted to create a custom external control panel, keeping the electronics as simple as possible but being expandable for more exotic needs. Thus far I have the 35 buttons I required, but we can expand on these using multiplexers such as the 74HC4067 for 16 controls for the cost of just 5 I/O Pins per block. If your control ambitions are slightly more modest you can make use of an Ardunio UNO that contains an 16U2 using the same principle described.

As we progress in part two your own feature feedback to the editor will lead the direction on what engineering efforts I put in. VMIX is excellent software for Amateur usage in a shack environment, and lowers the entry cost for PC Based switching solutions.

I found it slightly frustrating on seeing projects with no code and then no commercial supply either. It was quickly obvious to me how this was all being done.

In part two having covered the most basic setup elements we will move forwards and have some more interesting real control usage.

The project is as much to do with metal work as electronics, so in the next part will suggest a method of creating a PC Generated cutting and drilling template to ease this process as much as possible for the layout you want to create.

Web References

https://www.arduino.cc/en/Hacking/DFUProgramming8U2

https://www.microchip.com/developmenttools/ProductDetails/flip

http://www.midiox.com/

https://github.com/ddiakopoulos/hiduino

https://github.com/tttapa/MIDI_controller/releases/tag/3.1.0

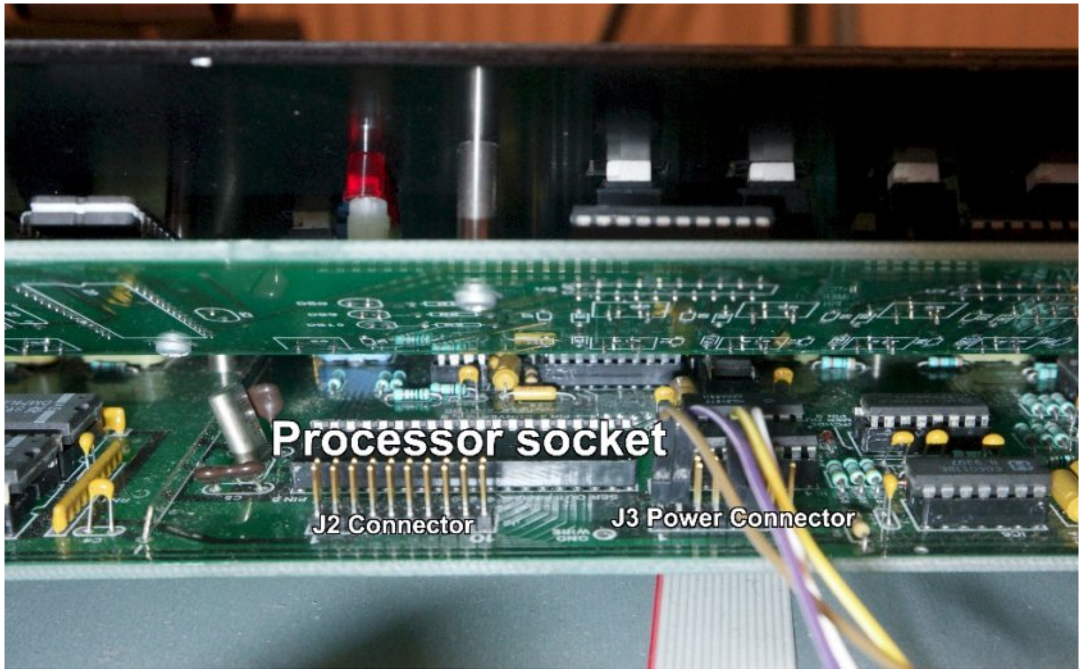
https://www.midi.org/specifications/item/the-midi-1-0-specification

Grass Valley Mixer Conversions - Part 2

Written by Trevor Brown G8CJS

In this issue I would like to start with the inner workings of this GVG panel. If we understand how it works we can then investigate how to interface it to something other than a GVG mixer, which was a brilliant mixer in its day, but was limited to mixing synchronous sources as were all mixers of that era.

The heart of the logic is a 6801 microprocessor and unfortunately this is not the kind of processor with an external EPROM, that would enable us to remove it, look at the code and perhaps on a good day change it, in order to make the panel do something more than communicate with the long gone GVG crate, but for now let's make it work without the processor. Lets remove the case and open up the unit, eight screws at the bottom and we are inside the control panel, leave the front panel in place, but remove the processor.



The unit requires two power supplies +9 and +14 ,the +14 can be eliminated by replacing the lamps with LED's and making a few wiring changes (see BAZ's site link) in the previous issue. For now I left mine as requiring a dual power supply.

J3 is the power and it is connected to the 15 pin D connector on the bottom so you can either power it through the D connector or remove the ribbon cable and connect to J3 direct.

D Connector	J3 IDC Pins	Connector Function
9, 10, 11	1, 2, 3	Ground
12, 13	4, 5	+14V Lamp Supply
14	6	Supply to on board 5V regulator

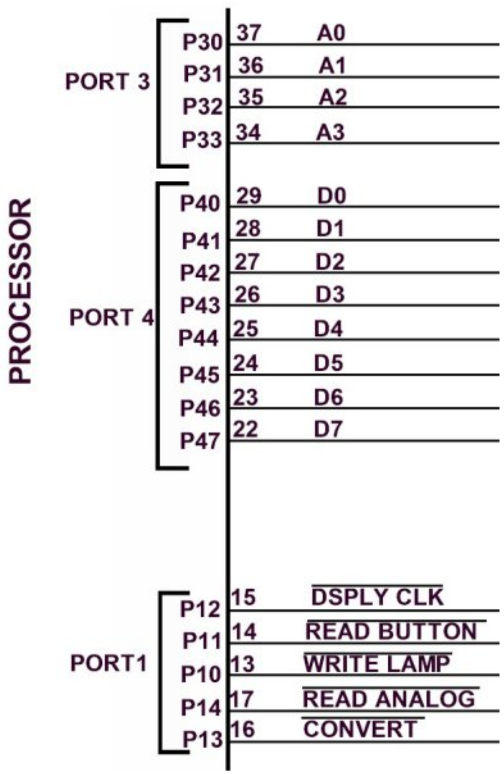
With the processor removed the only way to communicate with the panel is via the processor socket and a header plug or via J2 it's up to you.

The processor used to communicate all the button presses to the crate which in turn replied with which lamps to light, via an RS422 data link, again on the 15 way D connector , with the processor removed all this has gone and we have a very dumb control panel or have we? .

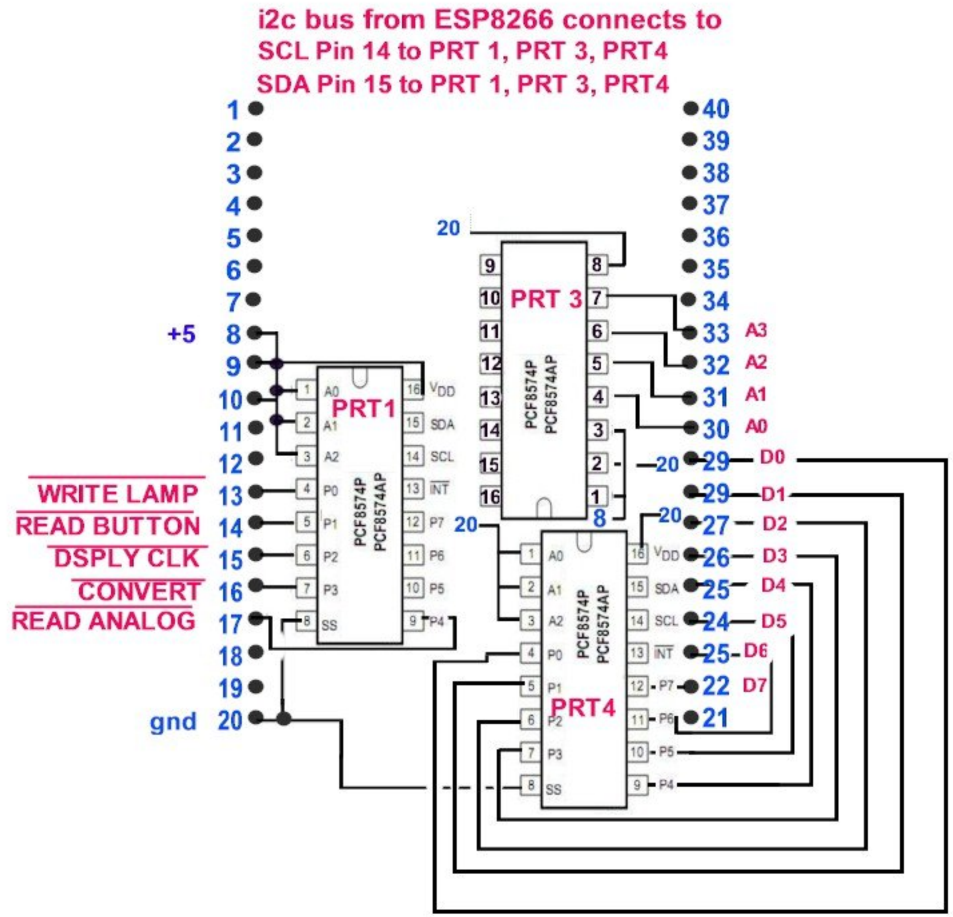
The processor I/O is where the state of all the switches and analogue pots are read and the panel lamps controlled via communications with the crate.

The processor has control over the panel via a 4 bit address bus, 8 data connections and 5 command lines these are all outputs from the processor, with the exception of the data lines which are bi directional.

If we can take possession of the 17 lines then we can do everything the processor did, all we have to do is map out the hardware, then working backwards plan how to read a button or light a lamp.



The GVG Processor I/O connections



The GVG Exploratory dongle

My first thoughts on pulling the micro was to fit a header plug and build on it three 8 bit I2C port chips (PSF 8574's), or plan B to interface the same three port chips via the J2 socket, where all of the 17 I/O connections are also available.

This then enables us to have I2C access to the control panel. Then we need a way to be able quickly to manipulate the I2C bus and verify we have control and map out the hardware and develop routines for controlling the mixer panel.

I decided to fall back on the ESP 8266 development module, it might be slow, but running ESP BASIC enables me to edit software in seconds and via the I2C bus control the three port chips, that now replace GVG processor. In this way I can make some sense of the hardware interconnections within the panel.

The three port chips essentially become an exploratory dongle providing I2C to interface the GVG panel. My junk box was without a header plug, so the I2C dongle was constructed on a prototyping board and connected to J2, but I still like the idea of an active header plug and this might be part of the final solution.

The ESP module is only for exploratory work, once we have the data, a better processor can be used to drive the I2C bus, something programmed in a language other than ESP BASIC although it is starting to grow on me.

Processor	J2 connector	Signal
	3	5
	1 & 2	GND
37	11	A0
36	12	A1
35	13	A2
34	14	A3
29	15	D0
28	16	D1
27	17	D2
26	19	D3
25	10	D4
24	8	D5
23	6	D6
22	4	D7
13	18	write to Lamps
14	20	Read Button
16	7	Convert
17	5	Read Analogue
15	9	Display Clock

Processor and J2 connections

I started an exploratory journey with the panel lamps. These are activated by a low on the GVG processor port 1, P 10 or processor pin 13, (pin 18 of J2) this opens up access to 8 lamp latches which are all 74C374, these are 8 bit data latches , that store the state of the lamps.

This is a good starting point for our project as success will be easily identified as the lamps illuminate. All we have to do is understand the lamp map and how to reach every individual lamp. There are 63 button lamps that can be illuminated and that's more than can be accessed by the 4 address lines on Port 3. The 4 lines are used to enable one of 8 data latches. The data inputs of these latches are all connected to the bi directional port 4 of the processor.

This enables individual access to a lamp or more than one lamp at the same time within the same latch.
Every lamp requires it's latch enabling via the address bus (along the top row) and the decimal word selecting from the left hand column. EG X and Y coordinates into the software.

PORT 4 single row word (decimal)	PORT 3 ADDRESS 0 latch LS0	PORT 3 ADDRESS 1 latch LS1	PORT 3 ADDRESS 2 latch LS2	PORT 3 ADDRESS 3 latch LS3	PORT 3 ADDRESS 4 latch LS4	PORT 3 ADDRESS 5 latch LS5	PORT 3 ADDRESS 6 latch LS6	PORT 3 ADDRESS 7 latch LS7
1	PGM 8	KEY 5	EFF KEY INV	KEY3	PST 3	FTB	KEY	
2	PST 4	KEY 4	EFF KEY MASK	ASPECT ON	PGM 0	DSK INV	BKGD	DSK MAT
4	PGM 9	KEY 7	EFF EXT	KEY 2	PST 2	DSK MASK	AUTO TRANS	OUTLINE
8	PST 5	KEY 6	EFF KEY BUS FILL	NB KEY LAMP POWER	PGM 1	DSK MIX	KEY 8	DSK EXT VIDEO
16	PST 9	PGM 7	EFF MATT FILL	KEY 1	PST 1	DSK PVW	WIPE	SHADOW
32	PST 6	PGM 4	PST PTN	NB PGM LAMP POWER	PGM 2	?	KEY 9	DSK EXT SOURCE
64	PST 8	PGM 6	CHROMA KEY	KEY 0	PST 0	UPPER LIMIT	MIX	BORDERLINE
128	PST 7	PGM 5	EFF KEY	NB PST LAMP POWER	PGM 3	LOWER LIMIT		DSK BUS SOURCE

The lamp map for the mixer

NB:- The control Latch LS3 needs enabling and Port 4 decimal word 8, 32 and 128 to be high to provide power before PGM, PST and Key buttons can be illuminated E.G. if Latch 3 is addressed and sent data word 8+32+12 = 168. 168 will enable the key PGM and PST lights to be powered, but they still need to be commanded on.

The map shows the address and how to illuminate any button using A0 to A3 which is decoded via an 74LS154 decoder with capacity to spare, the selected latch allows access to a 74LS 374 (8 D type latch) which in turn drive up to 8 individual lamp drivers . All the 74LS374 latches have their data inputs connected to Port 4 (the bi directional port). This enables the selection of a latch which will lock in the decimal word. The lamps are not arranged as I would like EG all the PGM buttons are not on the same latch.

This means turning on a PGM lamp can turn off a PST lamp. If you could read the latches you could add the illuminated PST lamp to the PGM selection and stop this undesirable effect. unfortunately the panel design does not allow the latches to be read, only written to.

Let's not be too hard on GVG remember this was a digital control panel, controlling an analogue mixer via a 9k6 baud serial connection. Only the changes could be sent it was not possible to scan all the functions and send them every frame at this data speed, and it was not needed as the mixer operation shows.

I am sure they had their reasons for the layout and I am sure with software we can store the lamp map addresses of the illuminated lamps sharing the same latch and ensure they are not extinguished when the latch is refreshed.

For the exploratory dongle I used 3 PCF8574P, apologies they we already in my junk box. For later packages refer to the data sheet, I am aware this is an old package.

I have called the three I2C ports 1, 3 and 4 so they match the ports on the original 6801 processor.

They all need different I2C addresses so PRT1 has A0 A1 A2 pulled high so it will have the highest address.

PRT 4 has A0 A1 A3 all grounded so it will have the lowest address and PRT 3 has A0 and A3 pulled high and A2 pulled low so it will have an address between the others.

The I2C connector on the ESP 8266 development kit is on GPI05 SCL and GPI04 SDA and don't forget to connect the ground across to the header and power the ESP via the USB input, I used the ESP 3v3 rail to power the ports and had no problems interfacing to the GVG processor I/O directly, 3V3 was seen as a logic 1.

Lets connect up our exploratory dongle and run the following software as our first foray into investigating if the panel can be of any use outside the purpose for which it was developed. The ESP 8266 is covered in CQ DATV 43 and it is available in the back issue library.

This I2C scanner software can then be pasted into the programme, run and the ports checked for their I2C address and functionality, its been covered also before in CQ-DATV 43.

```
I2C.setup(4,5)
for address = 1 to 127
 I2C.begin(address)
 stat = I2C.end()

 if stat  <  1 then
    wprint "Found I2C device at address: 0x"  &  hex(address)
  wprint " -  >  "  &  address
  wprint "  <br>"
 endif
next
wait
end
```

This is the screen printout when the scanner software is run, remember my port chips were PCF8574AP you might get different addresses for other suffix chips.

Found I2C device at address: 0x38 - > 56
Found I2C device at address: 0x3d - > 61
Found I2C device at address: 0x3f - > 63;
EG Port 1=63, Port 3=61 Port 4=56 remember BASIC is all decimal

With the dongle reporting back lets try and command the GVG Panel. If we run the following programme we should be able to lamp test all the lamps, by turning them on and off.

```
    ' GVG Panel Lamp test
let PRT1=63
let PRT3=61
let PRT4=56
 I2C.setup(4,5)
     I2C.begin(PRT1)        'set write lamps to low
       I2C.write(254)
      I2C.end()

for B=1 to 10          'number of flashes
  ' light all lamps
 for a=0 to 10
delay 10
I2C.begin(PRT4)        'data bus
   I2C.write(254)
    I2C.end()
     I2C.begin(PRT3)  'address bus
          I2C.end()
            next a

' clear all lamps
for a=0 to 31
 I2C.begin(PRT4)            'data bus
   I2C.write(0)
      I2C.end()
         I2C.begin(PRT3)  'address bus
           I2C.write(a)
             I2C.end()
next a
next b
end
```

All the lamps will light and flash 10 times and then go out, the software will cut and paste into the ESP Editor, one of the advantages of an electronic magazine.

In the next issue I will be digging further into the lamps and deriving an address code for each individual lamp.

Some light reading on the 6801 micro processor for those of you that like that sort of thing.

https://archive.org/details/bitsavers_motorola68ReferenceManualMay84_19173732/page/n13

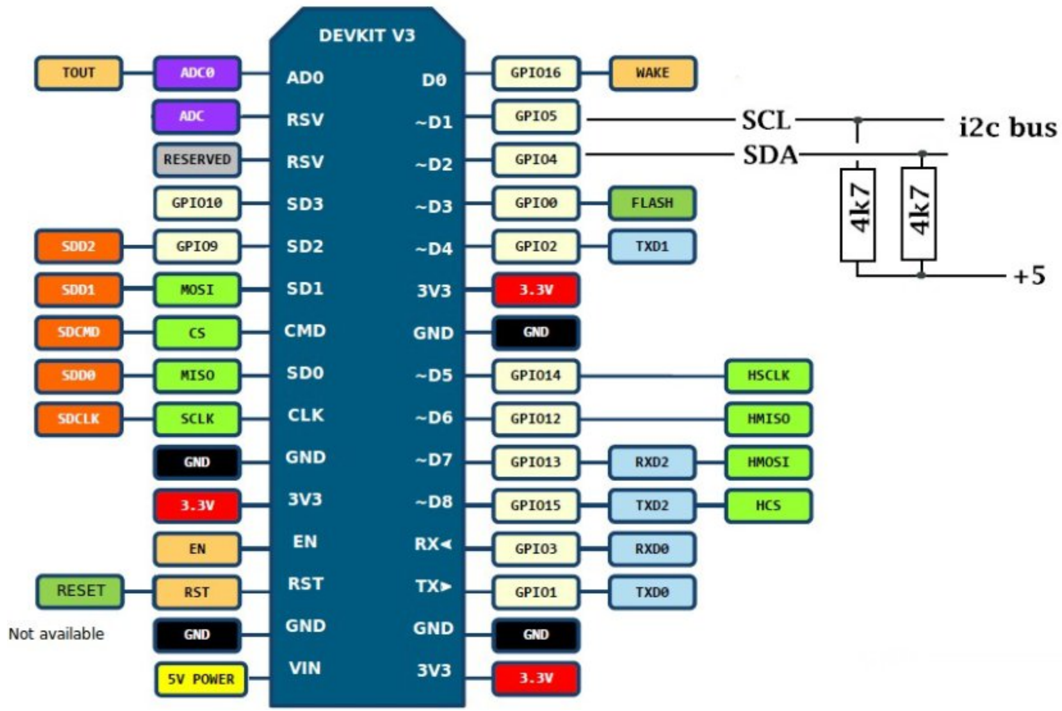
Introduction to the ESP 8266 micro kit

https://www.cq-datv.mobi/43.php

ESP BASIC instruction handbook

https://docs.google.com/document/d/1EiYugfu12X2_pmfmu2O19CcLX0ALgLM4r2YxKYyJon8/pub

ESP 8266 - one option for controlling the I2C Exploratory Dongle



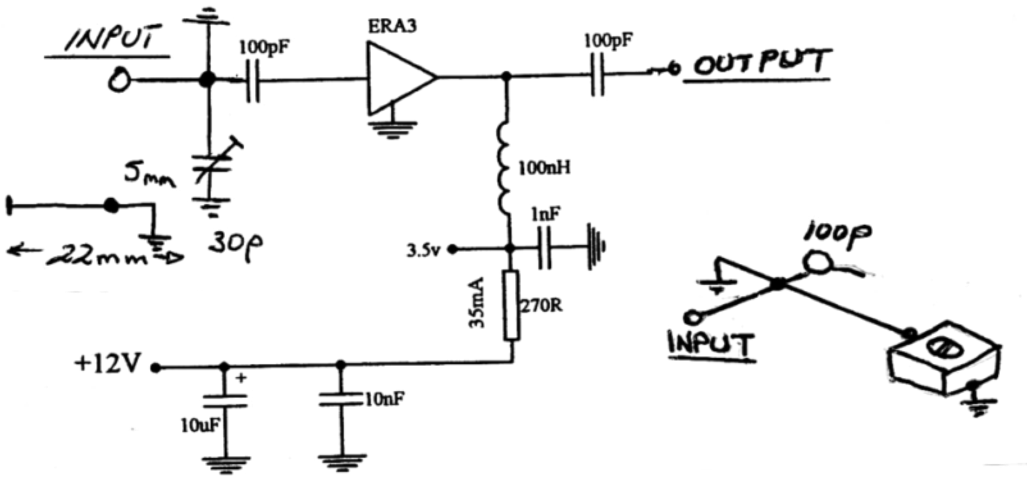
First published in issue 5

Simple Pre-amplifier for DATV

Written by Richard Carden VK4XRL

Some set top boxes like the Jaycar XC 4914 or Strong STB 5006 don't have a lot of gain. However the information page on the XC 4914 is very good showing most parameters associated with the digital signal. Therefore some form of pre-amplifier may be needed. MiniKits (Aust) have one for 70cm.
http://www.minikits.com.au/electronic-kits/rf-amplifiers/rf-preamplifiers/70cm-RX-Preamplifier

However a simple version using an ERA-3 can be used with a tuned input that works quite reasonable.



The circuit is shown above and can be fitted in a small diecast box. Tuning can be done with a received signal and adjusting the trimmer for minimum noise by looking at the waveform if you have those facilities or by just using the received picture. The ERA3 has a gain of 18.7 db with a noise figure of 2.8db. The output is rated at +13dbm at 2 GHz.

It requires an operating voltage of around 3.2v and this can be obtained using a 251 ohm resistor from +12v. This can be made from using parallel 470 and 560 ohm resistors or a 270 ohm resistor.

Happy DATV'ing

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