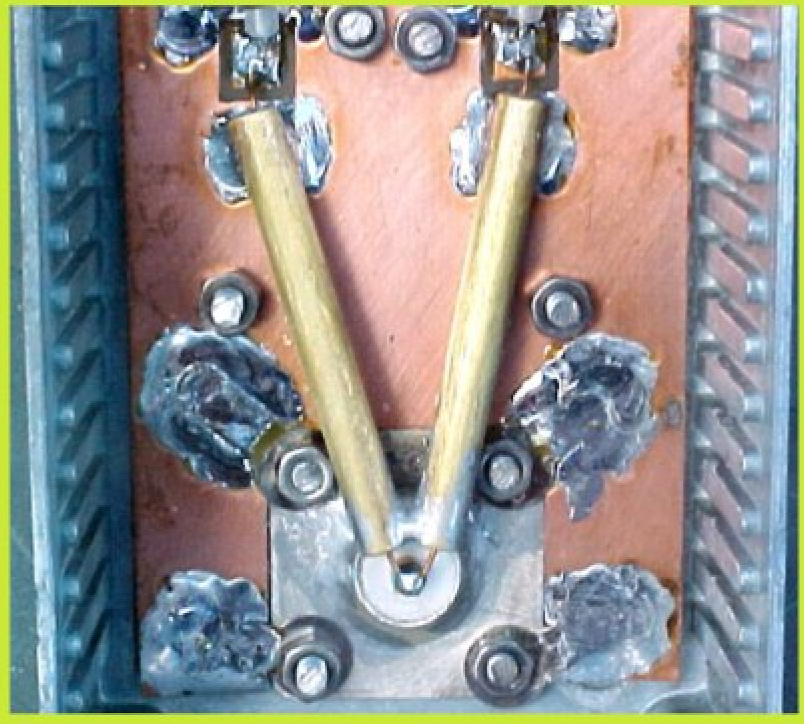
CQ-DATV

dotMOBI

Issue 13 - July 2014



http://cq-datv.mobi

In this issue

The team

- Ian Pawson - G8IQU
- Trevor Brown - G8CJS
- Mike Berry - G1LWX
- Ted Bottomley
- Richard Carden - VK4XRL
- John Hudson - G3RFL
- Dave Kenward G8AJN
- Ken Konechy - W6HHC
- Klaus Kramer - DL4KCK
- John Lukey - VK2ZUH
- Terry Mowles - VK5TM
- Clive Reynolds G3GJA / G8EQZ
- Mike Stevens - G7GTN
- Paul Wade - W1GHZ

DATV QSO Party

The annual DATV QSO party is scheduled for Friday 29th and Saturday 30th August. (Eastern Australian Standard Time). As with previous years Friday night will be a VK hook up and Saturday international.

More details later, but put this date in your diaries for this special event.

GB3FY report

John Lawrence, GW3JGA, reports the reception of GB3FY on 10.240 GHz as follows.

Received at P4 with fairly rapid QSB at 19.00 hrs on 15 May 2014 at SJ 087 833, 30m amsl (Prestatyn Cemetery!)

Conditions

WX ideal, 14deg C, 1300mb, calm. Sea path approx 39miles.

Kit

60cm Sat Dish, 9GHz LNB (Bob Platts) home built 23cms RX based on G1MFG RX and Maplin Monitor. I did not detect any sound above the receiver input noise.

The G1MFG receiver IF does not produce a very good overall video response. An alternative receiver might have produced a better test card result.

From a nostalgia point of view, it was lovely to tweak the dish slightly and watch the signal coming up out of the noise (not like digital).

Anyway, Congratulations to you and your team on getting the whole project up and running - excellent!

My TX for 3cms (which I did not try) is a Gunn diode into a 10dB horn - insufficient power to get into GB3FY. I found using a dish for TX was too critical both in matching and in direction setting. The solution might be to use a common dish with a waveguide switch, so I could set direction on receive ready for transmit.

A DXSpot view of "The summer fun contest"

Over the weekend 14th and 15th of June, there were two ATV contests running both in the UK and In the Netherlands. The DXSpot website was up and running and provided a view of where the stations were and who they were working. If you want to be seen you have to log in, the software is not telepathic, but it is useful if you want to know where to point your dishes and beams and encourage others to beam in your direction. The call signs are normally displayed as drop down click boxes, but we have overlaid them for CQ-DATV.

See http://www.dxspot.tv/

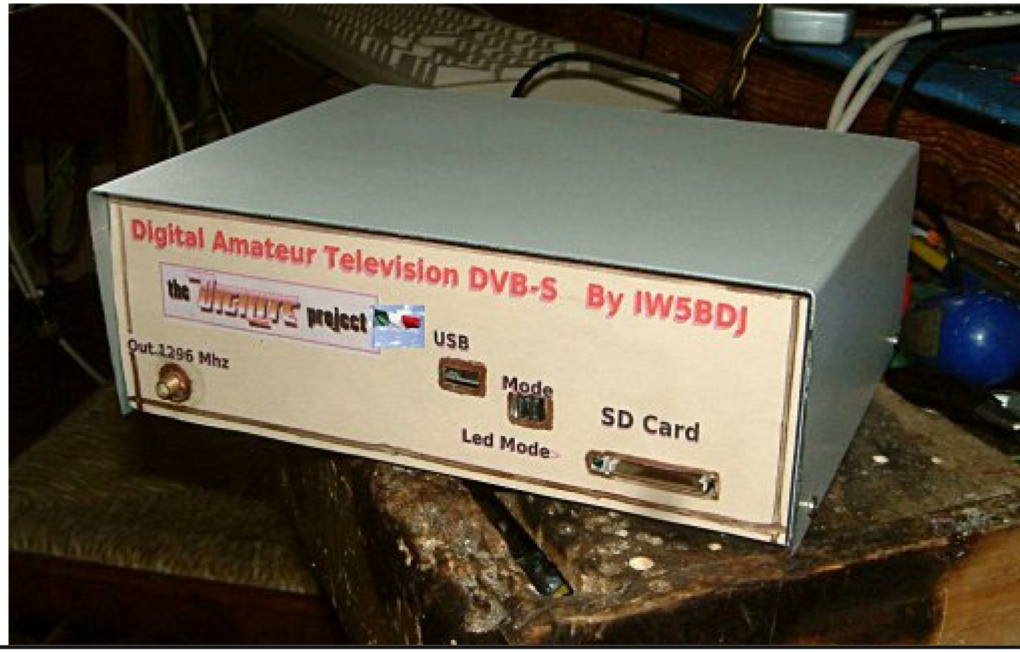
Fabrizio Bianchi reports

Yesterday, June 21, 2014 I presented to a group of radio amateurs from various parts of 'the Italian system DIGILITE DVB-S.

People from the city of Udine, Vicenza, Livorno, Grosseto, Florence and Siena from me.

There have been many compliments to the System.

Of course the most important things were discussed at the restaurant!...



Editorial

Welcome to CQ-DATV 13 not the luckiest of issue numbers, but providing we stay clear of a Friday launch we should be OK. In this issue Mike G8GTN is progressing with his on screen display module and also looking at infra-red control. John G3RFL has been adapting the OSD for use in GB3FY which has now been seen in Wales by John Lawrence GW3JGA, add that to the Isle of man reports and all John is waiting for is a report from Scotland.

Richard VK4XRL has produced another edition of digital world and also designed a ITS generator so you can add test signals to your transmission, sorry in advance if the complex circuit diagrams which have pushed electronic publishing resolution, but we have put the full diagrams as zip files on the download site. Peter VK3BFG has been working on matching 24cms aerials and Ken W6HHC explains DVB-S2 protocol, not a bad issue for the superstitious, just do not walk under any ladders reading it on your tablet and take extra care with the constructional projects, we don't want any blemishes on our perfect working record.

Our Facebook site has now changed to an open group, well isn't that what social media is all about. You have to be approved to post on the site, and our team will then visit your Facebook to check for ATV content and then you will be approved and given access privileges. No sooner had we made the changes than Fabrizio Bianchi IW5BDJ sent in the first request, we approved it and a few minutes later he made his first posting. Fabrizio has already constructed a DigiLite kit and is an avid DATV operator and constructor with quite a few of his own home designed projects that we hope you will be seeing more of in future editions of CQ-DATV.

Thanks in advance for taking the time to download this magazine, please let us have all your news and views either to the editor or now to our open Facebook group.

TV Amateur is a German language magazine. It is published 4 times a year. If you would like to subscribe, go to http://www.agaf.de/

MAX7456 eBay OSD Module Two Push Button Operation

By Mike G7GTN

Our OSD Modules captions can be easily controlled via two push buttons, one to advance through the available Captions (Set up for 15 at present) and the second to provide a Clear or remove caption feature.

Using the very simple circuit depicted in Figure 1, two push button switches and two 10K resistors are all that is required for this very basic operation.

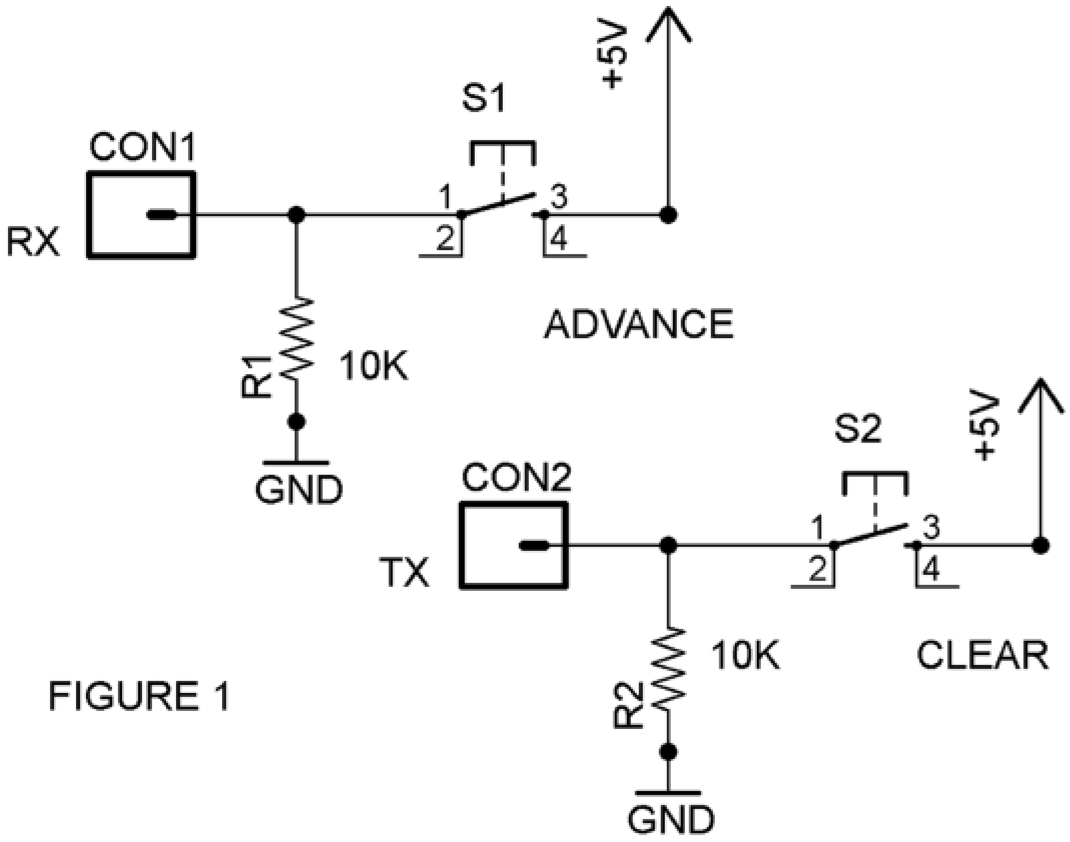
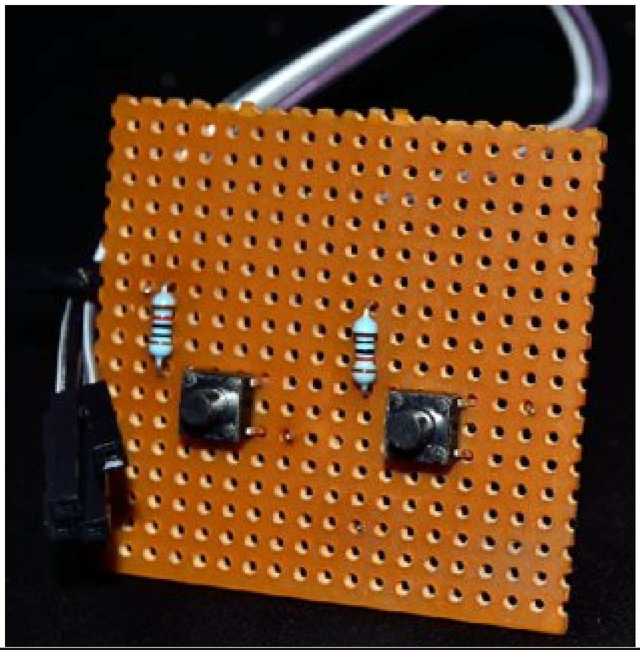


FIGURE 1

Our code is configured to look for Digital input on the RX (PD.0) & TX (PD.1) pins from the buttons and advance through the captions we have set up. A very quick explanation is probably in order on how the RX and TX pins of our OSD modules operate. The Ardunio Boot loader that is installed knows about these pins where our own code can either make these pins a Digital Input or an Output. When we download new code they are automatically set & used as Serial Data Pins by the Ardunio IDE. As long as in our own code we do not try to start any Serial communications with the standard command Serial.begin we can make use of these two pins in the manner we actually require. Which for this particular project will be just normal Digital I/O pins.

Construction

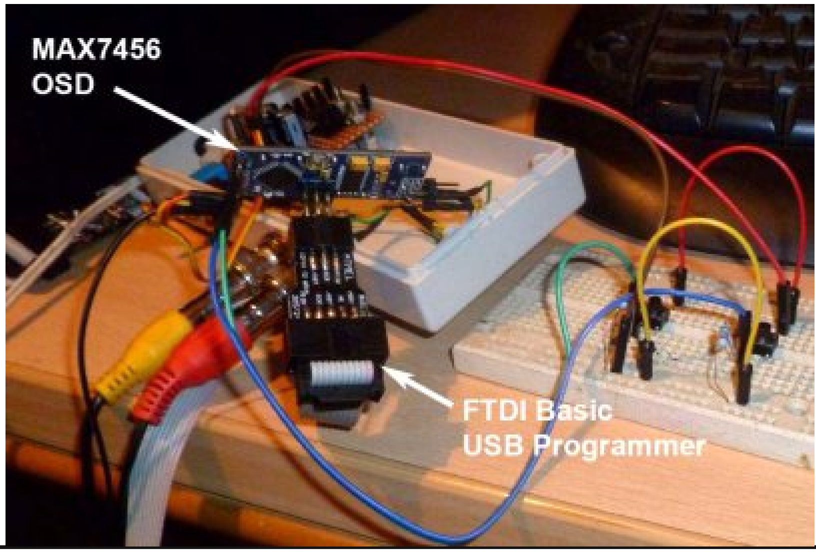
My two push to make switches were mounted on a small scrap of stripboard, the connection to the OSD module was made using two small female headers to allow them to be removed to programme the board using our familiar FTDI USB Breakout.



Operation

The supplied Ardunio code is configured for fifteen captions but of course you can easily modify this to suit your own personal requirements by simply extending further the already coded state expressions. On viewing the code & included comments it will be obvious how you can achieve this. The buttons are debounced using a software timer routine that is configured for 50ms delays; you can adjust this constant either up or down to better suit your own buttons if so required.

We start with no captions being displayed on the first press your first caption will be shown. This is advanced by pressing the button, on pressing the Clear button this is removed from screen and a software counter is reset to zero hence we start back off with Caption One again on the next press of the Advance Button. The cycle obviously then just continues to repeat onwards. One of my portable units has been configured in this simple fashion and proves quite useable and practical for me. Remember as well that if you remove the Video Input feed you end up using the MAX7456 internally generated syncs and a grey screen will be produced with your programmed text or captions on.



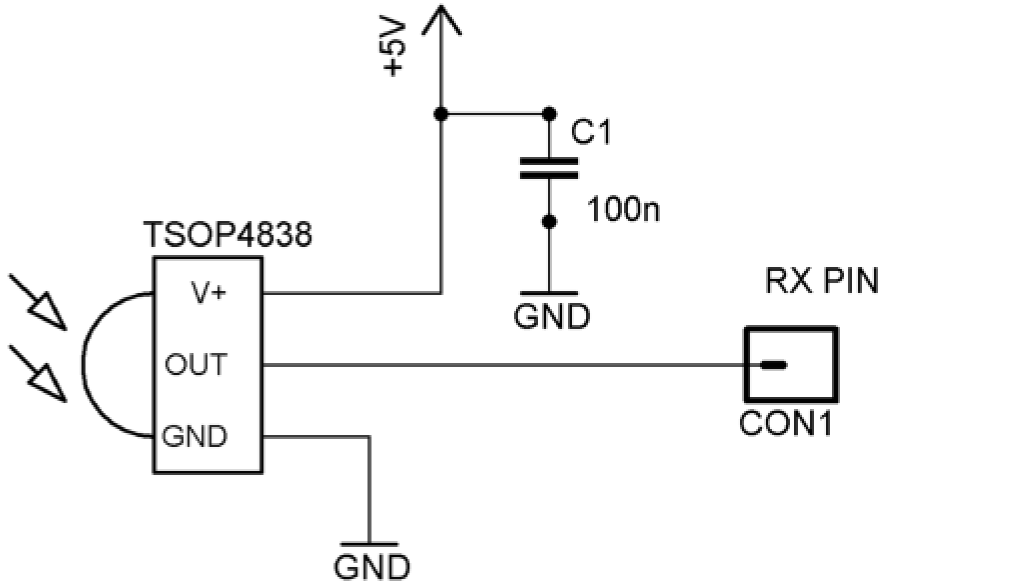
We will again make use of our FTDI Basic USB Breakout (or you can of course connect an AVR ISP programmer directly) board to load the code on to the module. The source code file is called OSD2BUTTON.INO and available in OSD2BUTTON.ZIP from the usual CQ-DATV project download web location.

MAX7456 eBay OSD Module Sony IR Remote Control

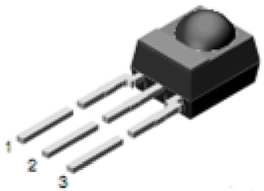
By Mike G7GTN

Our small MAX7456 OSD modules can also easily be controlled via Sony IR (also called SIRCS) remote control using nothing more than a single IR sensor and some easy to implement software changes to the Ardunio code we have run on the board thus far.

We use very simple Sony IR decoding hardware as depicted here, which just comprises the 38 KHz IR sensor and a single filter 100nf capacitor for the supply voltage.



The IR sensor contains an internal bandpass filter. The output pin of the sensor is simply fed directory to the OSD Modules RX data pin.



MECHANICAL DATA

Pinning

1 = OUT, 2 = GND, 3 = V_S

Shown is the physical device pin out for a Vishay TSOP4838 make certain to check the datasheet for the exact pin out for your own device as this might be slightly different.

We will use an already created and project proven Sony IR library to decode the remote commands in to hexadecimal for us to act on within our own coding. Further & better information on this library is available from the original Authors web site http://www.righto.com/2009/08/multi-protocol-infrared-remote-library.html

Firstly we need to install the IR decoding library in to our Ardunio IDE libraries folder. This can be found in the OSDSONY.ZIP file available from the usual CQ-DATV file download location.

You need to make sure that the contents of the remote decoding library file is placed in to a folder (directory) named IRremote. This will have the three files shown when this has been correctly installed.

\Ardunio\Libraries\IRremote

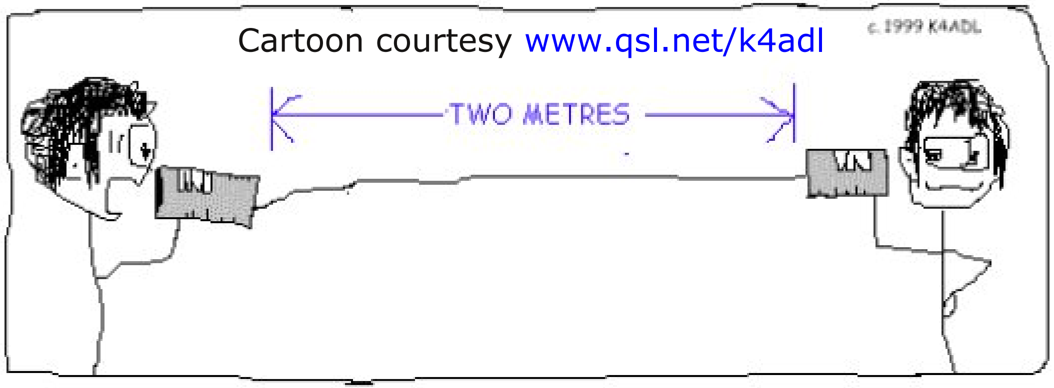
IRremote	C++ file
IRremote	Header file
IRremoteInt	Header file

The SONY SIRCS protocol is slightly unusual in that the 45ms timed frame gets decoded three times, and hence within our code we just throw away two of these instances using two lines of code. Each individual button produces a Hexadecimal code when pressed and from this we decide which Caption we want to display, a small remote table is provided in the source code to save you having to look up common key combination codes for yourself. The project download has a sample sketch called 'OSDSONY.INO' which should be placed in a sub directory. This is loaded on to the Module via the Ardunio IDE using our familiar FTDI breakout board. Obviously you need to switch my sample captions and Callsign for the data you wish to actually radiate. The captions start from Line # 87 onwards.

The following buttons will activate the Captions you have programmed the module with, 1- 9 display these individual captions. Pressing the Zero (0) Button will clear the currently displayed caption. The Power button will provide a software reset on the MAX7456 device. The coloured teletext buttons will allow the White level of the characters to be set, this ranges in percentage terms from 80% - 120% these values are written to the Micro controllers Eeprom and restored on the next power up cycle.

Whilst I have a quite considerable collection (must be another hobby interest) of redundant remote controls I have no original Sony branded controls and hence made use of two generic universal remotes to fully test the project with. This worked fine using the Sony device code 129 entered on both of my available handsets.

This is a really simple addition to the OSD Module and provides a different means of control which you may find works in your particular shack or operating situation. Add some of your own simple programming and these modules start to become quite versatile & good fun units.



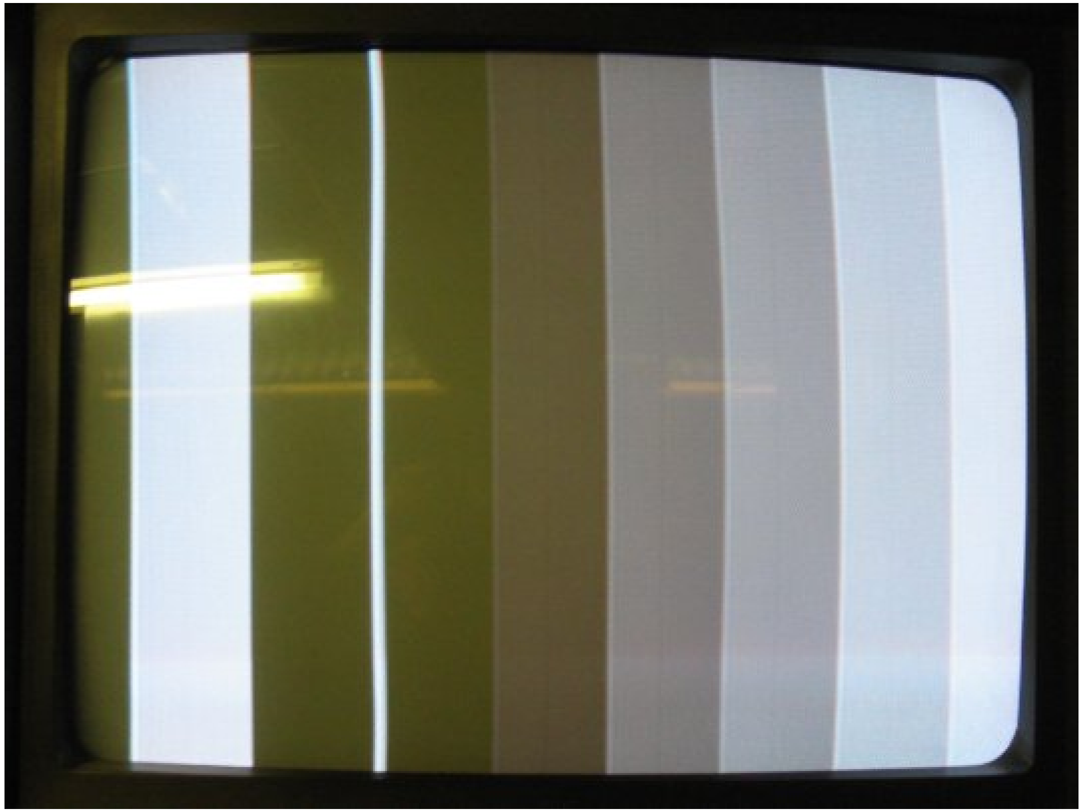
THE EARLY YEARS

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.

Digital Test signal generator or ITS Inserter

By Richard Carden VK4XRL

Would you believe this project started out as a simple audio/video distribution system? I was however approached to provide some form of test signal other than colour bars for VK4TVD's ATV system and then while I was at it I thought what about providing a suitable insertion test signal for setting video levels. Searching back through CQ-TV I came across an article by D.J. Long G3PTU in CQ-TV No.97 called "An ITS Generator". Not many articles have been produced on this subject so I thought this may fill the void.

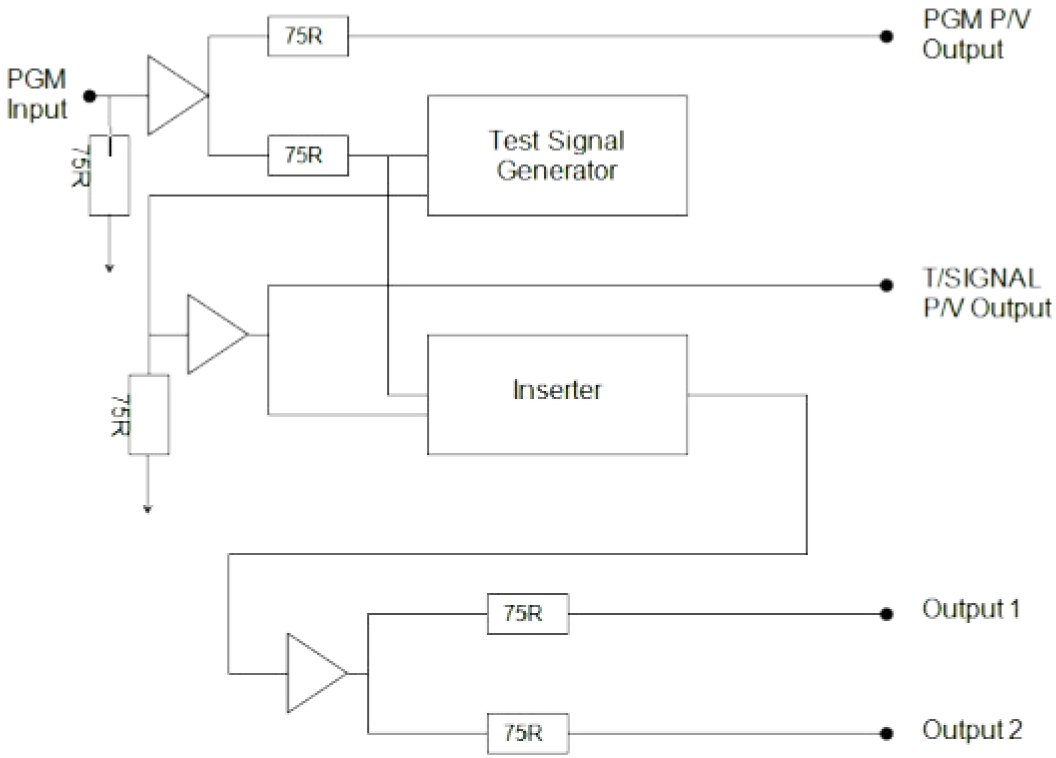


Full field test signal - Pulse and Bar (HF and LF test) combined with a staircase for linearity, viewed on a picture monitor

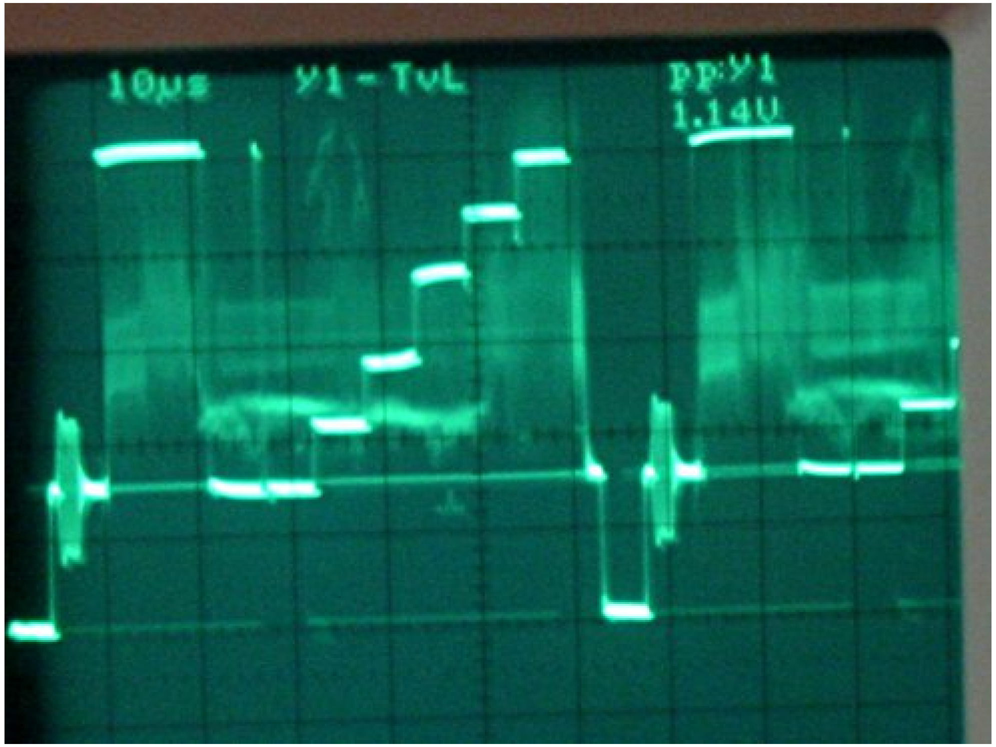
I started of using the ideas based on the circuit as supplied in CQ-TV 97. However I wanted to use CMOS devices. For some reason I was unable to obtain the same results and also a direct equivalent for the 7413 could not be found. Also the shift register circuit using a 74HC74 and 74HC164 wouldn't work unless you used a normal 7474. The ideas used in this circuit arrangement weren't lost though, so armed with this, a new circuit was developed.

Test Signal Generation

The block diagram shows the basic requirements and is drawn as such, as this was how I approached it. For the



prototype the OP amps were already available on a PCB using a MAX 497. The circuit is however drawn with different OP amps when built as a complete unit.
Incoming program video is feed via two paths, one to the video inserter and the other to the sync separator to provide the required digital pulses. The sync separator is the now familiar LM1881, this produces MS, VS and Burst as required by the rest of the circuit. The first pulse required is horiz Blanking. I tried a couple of simple non-retriggerable monostables consisting of a flip-flop formed by two cross-coupled NAND gates. While these worked it was decided to try a 4098 IC monostable which has two per package. This would reduce the overall component count and would be much simpler to implement. Looking at the circuit, -ve MS sync is fed from LM1881 (pin 1) to the 4098.



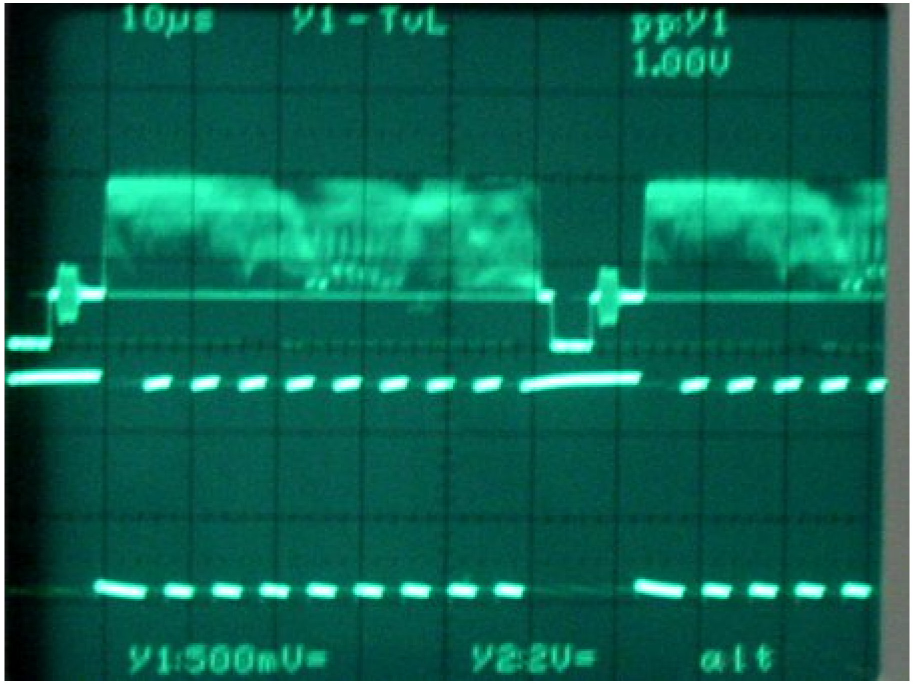
Full field test signal - pulse and bar (HF and LF test) combined with a staircase for linearity viewed on a waveform monitor (line rate)

The timing components are selected for a pulse duration of approx 10.5us. The +ve pulse from pin 6 is then fed to pin 11, where the -ve edge triggers the second monostable producing a -ve pulse at pin 10. The duration of this pulse is around 52us, the duration of the active line period. At this stage pins 3 and 13 are tied to +5V.
The next part of the circuit is the clock oscillator using a 74HC132. The clock oscillator is switched on and off from the above horizontal BLK signal, the frequency being adjusted so the last stairstep is completed before the start of H.BLK. The shift register is made up from a 4015 and is clocked from the above oscillator. The data input is fed from a separate 4098 to produce a pulse approx 5.8us wide while the reset is fed from pin 9 -ve H.BLK. The data is then clocked at intervals along the line. Each output is fed via a diode and resistor network before being summed across the 1k resistor to provide the basic test signal. Because the data from 4015 (pin5) has been clocked it starts approx 5.8us after H.BLK. Therefore to provide a more standard bar output the -ve data pulse output is gated with the output from 4015 (pin5) via an inverter to produce the bar output. Also the pulse waveform is produced from the differentiator formed by the 27p and 10k resistor and feed via Schmitt gates to the summing network.

This combined output is then fed to a video OP amplifier where its level can be adjusted. Its output is then fed via a Gaussian Filter to the inserter. Because sync has been added to the test signal H.BLK now sits at +0.3V, therefore a -ve offset is required to set the test signal blanking to the incoming program blanking. This is provided by the fixed 15K and 5K pot connected to the -5V rail.

Inserter

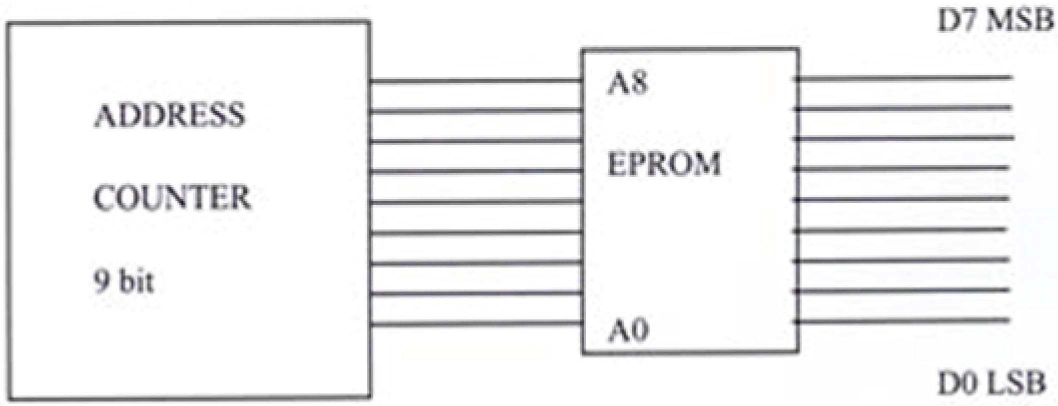
The incoming program video needs to be clamped before the test signal can be added to the signal. I was unable to obtain a EL4089 but had some EL4090 IC's left from another project, either one will work. Program video is now clamped with blanking at 0V. Burst pulse from the LM1881 is used as the clamp pulse feed to 4090 (pin 7). PGM video level can also be adjusted at this point. Clamped video is now fed to a 4053 (pin12) a triple two channel analogue multiplexer IC. Pin 13 is the test signal feed from another OP amplifier which also provides a separate test signal output. The output from the analogue switch (pin 14) feeds another video OP amplifier providing four separate outputs. Unused inputs and address lines being grounded. The switching signal (pin 11) is derived from ITS BLK and H. BLK.



Clock oscillator (bottom trace) switched on and off from the above horizontal BLK signal (top trace)

ITS Switching

While investigating this part of the circuit I came across an article on descrambling related to encoded satellite signals (Ref.4). Suitable gating can also produce the required switching signal, however the approach using an EPROM was



cleaner and simpler. I have never used this method although I have seen it done before (Ref.5).

Unfortunately the EPROM character generator chart in the above article had a few errors, also I wasn't sure how to go about providing the data to program the EPROM. A cry of help to Mike Cox provided me with the answers I needed and I greatly appreciate the help given. Since this was new to me

D7 [MSB]	D6	D5	D4	D3	D2	D1	D0 [LSB]	HEX	NUM.
1	1	1	1	1	1	1	1	FF	255
1	1	1	1	0	0	0	0	F0	240
0	0	0	0	1	1	1	1	0F	15
1	0	0	0	0	0	0	0	80	128
0	1	1	1	1	1	1	1	7F	127
0	0	0	0	0	0	0	0	0	0
Highest 'Nibble'				Lowest 'Nibble'					

I have covered the requirements below.
A 4040 counter was used, clocked by -ve sync (pin 10) and reset (pin 11) from +ve VS via an inverter from the LM1881 (pin 3). Since we require the decimal 313 which is 10101001, which means we need a counter/decoder that can handle nine lines. The 4040 can output the correct count, but the

decoder must be able to 'watch' nine lines. The EPROM is an elegant one chip solution to the problem. Unused address lines of the EPROM are grounded.
The EPROM used was a 27c64, however a 2716 could do the job as well. D0 (pin 11) is the ITS BLK. Signal and is fed to one input of a 74hc00 gate while the other input is fed by H.BLK. The output is five lines of H.BLK (i.e. lines 17 to 21). Five lines were used to provide easier reading of the test signal with program video. The output from this gate is inverted in another 74hc00 gate while the other input is tied high. Grounding this produces the full field test signal.

Power Supply

The power supply requirements are easily met by a 7805 regulator to provide the +5v supply. The -5v is derived from a DC-DC converter feed from the +5v supply via a filter to remove high frequency switching being feed back to the +5v supply line.

EPROM Programming

EPROM's can be used in two ways:-

They can be followed by a DAC, in which case the hex value programmed in to a specific location will give the output dc for that location. Example:- a location programmed with a hex value of 80 will give an output of ½ the DAC reference voltage.

An 8 bit EPROM can be used so that each location acts as a store of 8 individual bits of information. Each bit can be programmed to be 0 or 1; however the location must be programmed as an 8-bit word. Thus at each location, the 0s or 1s must be translated into a hexadecimal number for the benefit of the programmer.

The information in Table 2 may help.

ITS GENERATOR EPROM INFORMATION

LINE	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Hex
4	00h	0	0	0	0	0	0	1	0	02h
5	01h	0	0	0	0	0	0	1	0	02h
6	02h	0	0	0	0	0	0	1	0	02h
7	03h	0	0	0	0	0	0	1	0	02h
8	04h	0	0	0	0	0	0	1	0	02h
9	05h	0	0	0	0	0	0	1	0	02h
10	06h	0	0	0	0	0	0	1	0	02h
11	07h	0	0	0	0	0	0	1	0	02h
12	08h	0	0	0	0	0	0	1	0	02h
13	09h	0	0	0	0	0	0	1	0	02h
14	0Ah	0	0	0	0	0	0	1	0	02h
15	0Bh	0	0	0	0	0	0	1	0	02h
16	0Ch	0	0	0	0	0	0	1	0	02h
17	0Dh	0	0	0	0	0	1	0	1	05h
18	0Eh	0	0	0	0	0	1	0	1	05h
19	0Fh	0	0	0	0	0	1	0	1	05h
20	10h	0	0	0	0	0	1	0	1	05h
21	11h	0	0	0	0	0	1	0	1	05h
22	12h	0	0	0	0	0	0	1	0	02h
23	13h	0	0	0	0	0	1	1	0	06h
24	14h	0	0	0	0	0	1	1	0	06h
25	15h	0	0	0	0	0	1	1	0	06h
26	16h	0	0	0	0	0	1	1	0	06h
27	17h	0	0	0	0	0	1	1	0	06h
28	18h	0	0	0	0	0	1	1	0	06h
29	19h	0	0	0	0	0	1	1	0	06h
30	1Ah	0	0	0	0	0	1	1	0	06h
31	1Bh	0	0	0	0	0	1	1	0	06h
32	1Ch	0	0	0	0	0	1	1	0	06h
33	1Dh	0	0	0	0	0	1	1	0	06h
"	"	"	"	"	"	"	"	"	"	"
310	133h	0	0	0	0	0	1	1	0	06h
311	134h	0	0	0	0	0	0	1	0	02h
312	135h	0	0	0	0	0	0	1	0	02h
313	136h	0	0	0	0	0	0	1	0	02h
314	137h	0	0	0	0	0	0	1	0	02h

Table 2 (Reference Mike Cox June 2004)

The vertical reset pulse from the LM1881 (pin3) starts around line 4. Therefore drawing up a table as shown enables you to work out the hex code required by the EPROM. D0 is the ITS BLK pulse, D1 the inverse of the above while D3 is used as the pseudo vertical blanking. This output was added after the initial design and could have been feed to the first mono-stable 4098 (pin3) if required. By utilizing an extra address line (A9) it would be possible by programming the EPROM so

Pulse and bar and grey scale again, this time combined with picture during frame blanking

each alternate line was on and off (i.e. 1 or 0), this them makes it very easy to set-up the unit. This also can be achieved by a jumper pin to pin 9 4040 or pin 10 27c64.

Setting Up

Remove VTS BLK lead from pin 11(27c64) to pin 9 (4040) or pin 10 (27c64). This will produce alternating program and test signals on the output.

(1) With 1V P/P program input, adjust PGM output level for 1V P/P output.

(2) Set ITS test signal blanking adjustment to match program video.

(3) Set ITS test signal level for 1VP/P.
(4) Check H.BLK width and set the first M/stable AOT for correct finish of H.BLK, next set the second M/stable foe correct start of H.BLK.

(5) Set last stair-step trailing edge to finish at the start of horizontal blanking (i.e. 1.5us before start of sync. Pulse).

Reference

(1) CQ-TV198 Circuit Notebook No.77

(2) CQ-TV199 Teletext Encoder

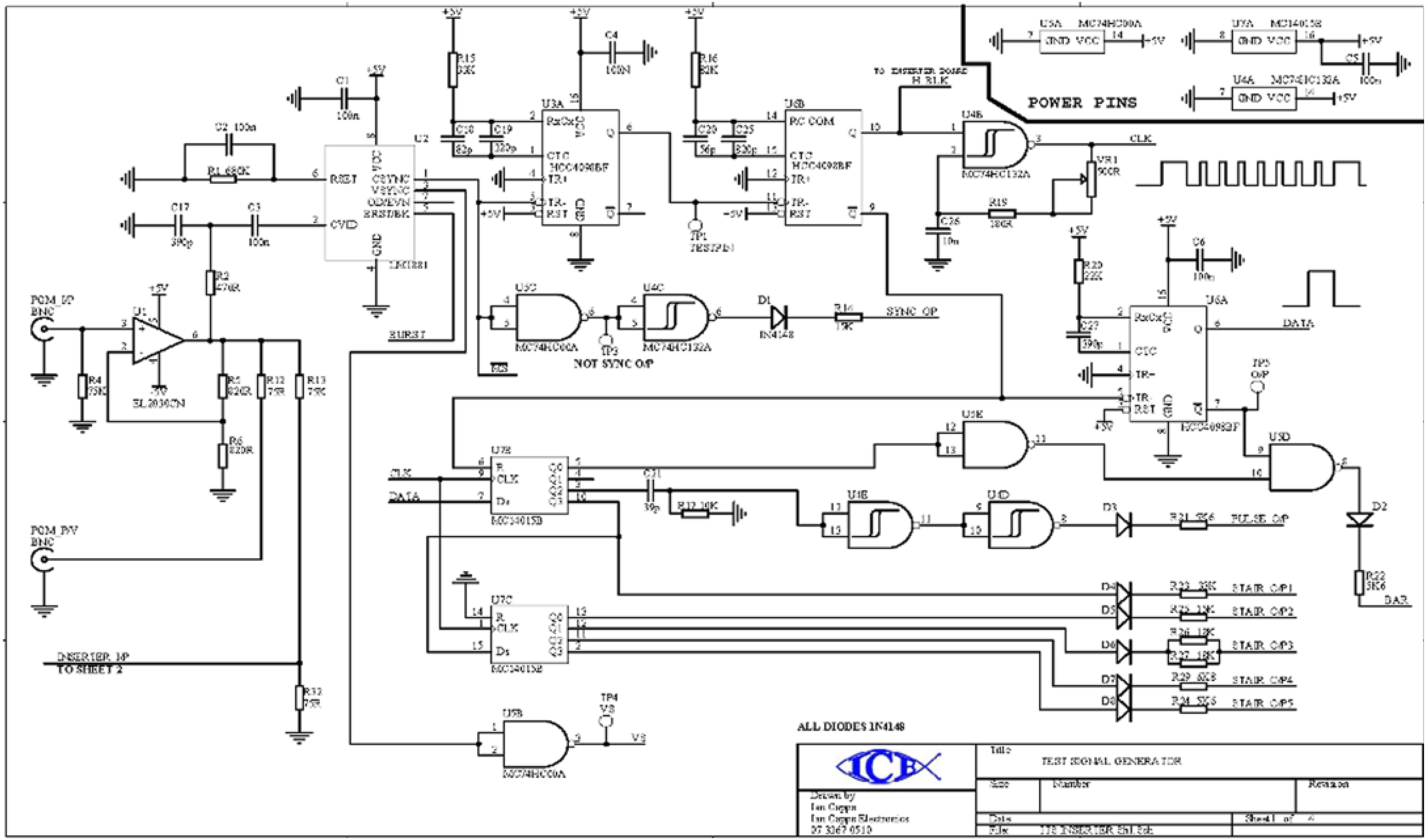
(3) Elantec Application Note 3

(4) Electronics Now April 1993 (Video Scrambler)

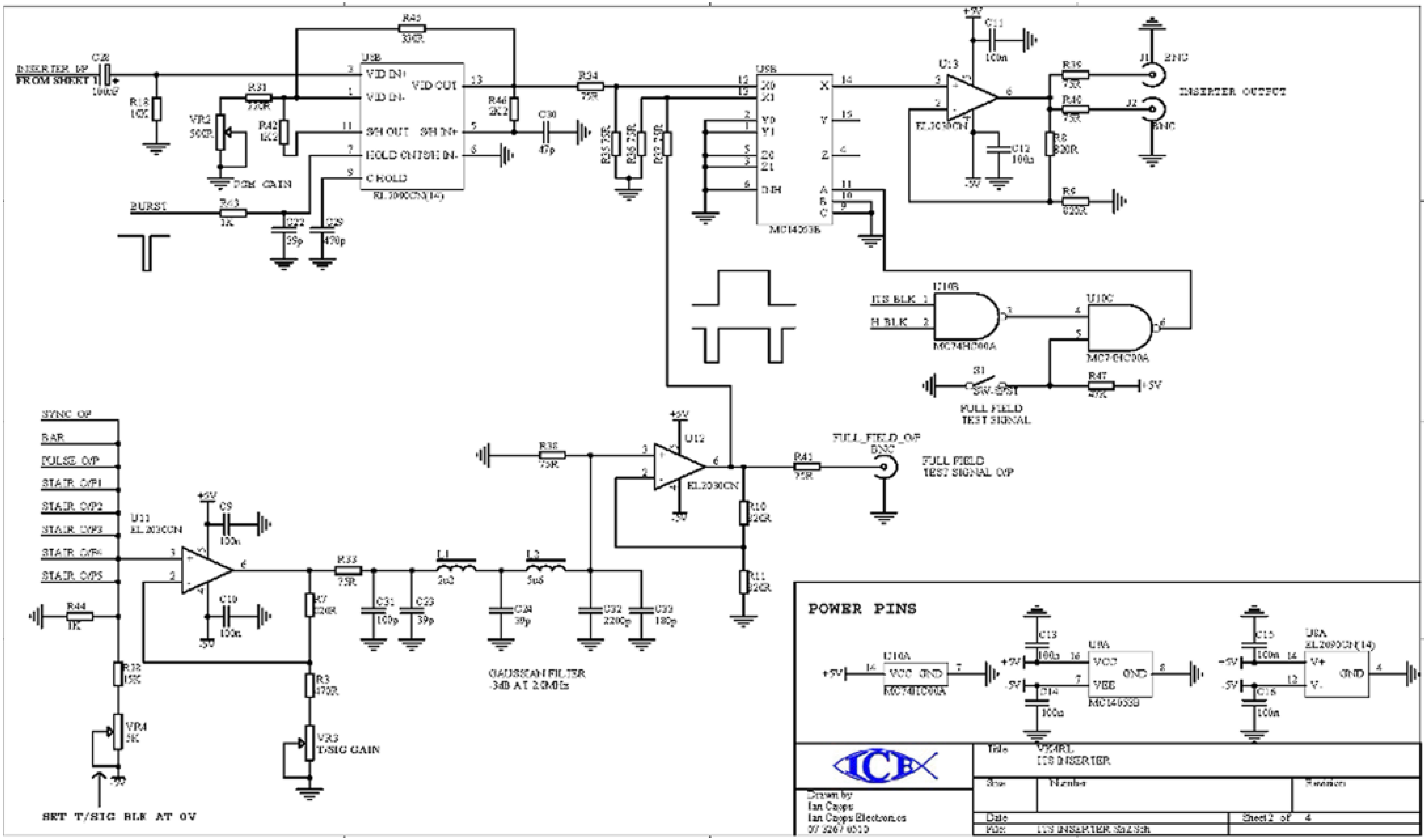
(5) CQ-TV 189 Burned in Monitoring

(6) CQ-TV 97 An ITS Generator

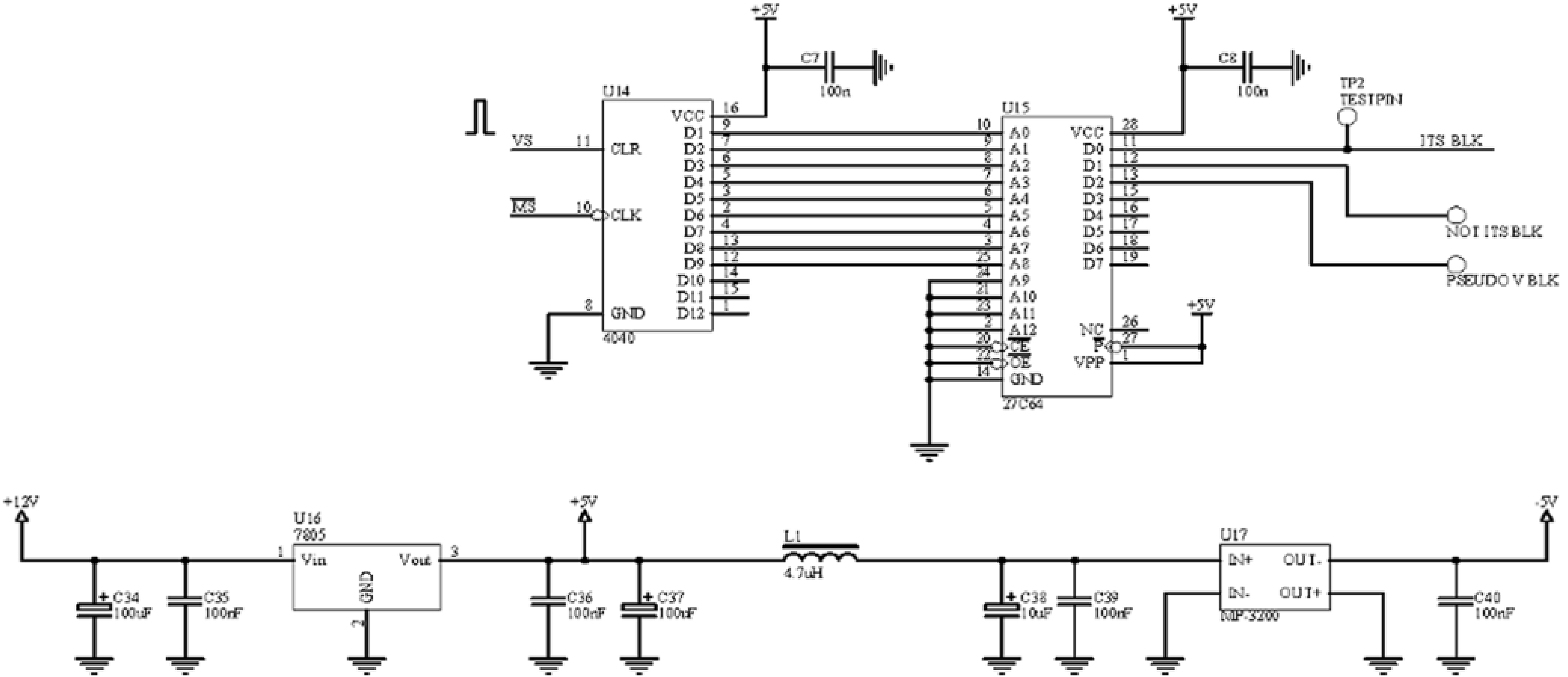
Circuit diagrams follow on the next 3 pages.



Digital Test signal generator - sheet 1



Digital Test signal generator - sheet 2



Digital Test signal generator - sheet 3

Note: High resolution copies of the circuit diagrams can be downloaded from the cq-datv.mobi website download pages.

DATVtalk10 - DigitalATV Understanding DVB-S2 Protocol

by Ken Konechy W6HHC

Reproduced from the Orange County Amateur Radio Club newsletter. www.W6ZE.org

[Please Note - This is the ninth article in a series of DATVtalk articles to introduce Digital-ATV to hams and to explain various aspects of this new area of ham radio. In the CQ-DATV5 issue, the DATVtalk02 article was the beginning of this series and presented an introduction article about Digital-ATV.]

Many of the earlier DATVtalk articles about Digital-ATV have provided details about how DVB-S modulation works. DVB-S is currently the most popular modulation standard being used by hams for DATV. This month I will look at some of the technical details of DVB-S2 protocol/modulation.

While the majority of DATV hams use DVB-S modulation and some hams use DVB-T modulation (see DATVtalk09), I have had many conversations with hams who propose that ham radio should move on to DVB-S2 modulation for Digital-ATV. I am a big advocate of understanding all the competing DATV technologies and protocols, since each technology has its own set of strengths and weaknesses (aka: PROs and CONs). So let us see, if DVB-S2 can improve ham radio Digital-ATV?

Commercial World of Television

The Digital Video Broadcasting organization (DVB) created the DVB-S standard to carry Standard Definition digital satellite transmissions. The Digital Video Broadcasting organization (DVB) approved DVB-S2 to be the modulation technology for commercial High Definition TV (HDTV) broadcast satellite transmissions (uplinks and downlinks). The DVB organization succeeded in getting DVB-S2 approved as an ETSI standard in March 2005. The DVB organization states that "DVB-S2 will not replace DVB-S in the short or even the medium term, but makes possible the delivery of services that could never have been delivered using DVB-S".

Some of the commercial TV design goals for DVB-S2 are:

- *Quasi-Error-Free operation at about 0.7dB to 1 dB from the Shannon limit*
- *Optimized for multi-stream HDTV*
- *Interactive Services (IS) Interactive data services including Internet access*
- *Digital TV Contribution and Satellite News Gathering (DTVC/DSNG)*
- *Data content distribution/trunking and other professional applications (PS)*

I find it interesting to note that other than the first bullet above, none of the services and features in the other bullets are not of much interest to hams.

Typical Transmitter Block Diagram

DATV pioneer and enthusiast Stefan Reimann DG8FAC of SR-Systems in Germany has shown that DVB-S2 digital technology is possible for hams (see the SR-Sys model 2TS-MidiMOD2). Fig 1 is a block diagram of a basic DVB-S2 ham station for DATV. The analog camera and video is compressed by a MPEG-2 encoder board. The TransportStream (TS) digital data is fed to the DVB-S2 exciter board that does a lot of complicated data processing and then converts the digital data directly into modulated RF at a desired frequency. The small RF output signal of the exciter board is typically amplified by two stages of very linear RF amplifiers.

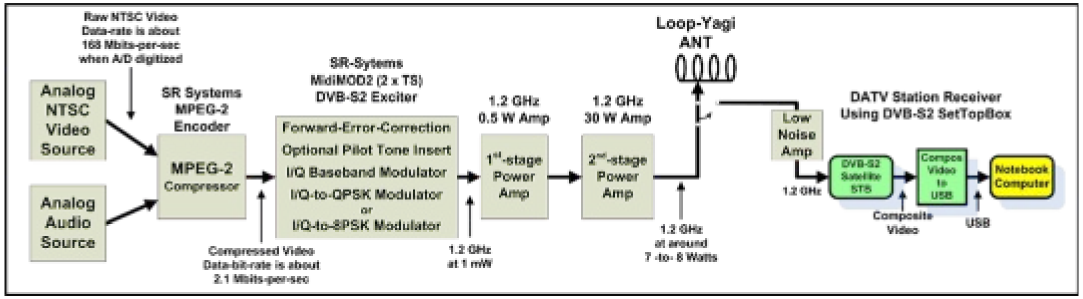


Figure 1
Block Diagram of Basic DVB-S2 Station for DATV

In Fig 1, the familiar DVB-S SetTopBox (STB) is replaced by the newer generation DVB-S2 STB in order to process newer FEC algorithms and additional modulation technologies.

Video Data-Rate and Compression

For DATV, the analog camera output is first digitized by the MPEG-2 Encoder board shown in Fig 1, and then compressed by the MPEG-2 algorithm. The reason the compressed video data rate varies in Table 1 is that the small value means little motion in the video scene and the larger value means a lot of motion.

Table 1 – Camera Video Data Streams and MPEG-2 Data Streams

Video Data Stream	Data-Rate	Notes
Analog NTSC camera	168 Mbits/sec	A/D digitized, uncompressed
NTSC MPEG-2	2-3 Mbits/sec	compressed
NTSC H.264/MPEG-4	~1.5 Mbits/sec	compressed
VHS MPEG-2	1-2 Mbits/sec	compressed
Analog PAL camera	216 Mbits/sec	A/D digitized, uncompressed
PAL MPEG-2	2.5-6 Mbits/sec	compressed
HDTV camera	1-1.5 Gbits/sec	uncompressed
HDTV MPEG-2	15-60 Mbits/sec	compressed
HDTV H.264/MPEG-4	12-20 Mbits/sec	compressed

Notice in Table 1 that the digitized NTSC camera video stream data-bit-rate is 168 Mbits/sec before compression, and MPEG-2 will reduce this to a Net-Bit-Data-Rate between 1 and 3 Mbps, which is quite a reduction in the data rate.

The newer video CODEC, H.264, can be also used with DVB-S2. This CODEC is sometime called H.264, sometimes called MPEG-4-Part-10, and sometimes called Advanced Video Coding (AVC). But, all of these terms mean the same standard, technically. H.264/MPEG-4 can reduce the bit rate by a factor of 50% over MPEG-2. Note that NTSC/PAL cameras can be used with the H.264 CODEC to reduce the video data-bit-rate needed and still obtain MPEG4 Standard Definition (SD) out (720x576 or 480). But, it is also important to realize that hams can transmit DVB-S2 using MPEG-2 encoding and the transmission will be received OK on DVB-S2 SetTopBoxes.

FEC Inflation of Payload Data Stream Data-Rate

Forward Error Correction (FEC) is a technology that not only can detect errors on the received signal, but adds enough redundancy of the data so that it can correct several wrong bits. But, there is a trade-off when choosing the amount of redundancy. Since redundancy inflates the data-rate of the output stream, the trade-off is between more redundancy or keeping the inflated data-rate smaller. As we will see a little later in this article, the larger the inflated output data-rate, the higher the required RF bandwidth. So at some point the FEC algorithm will not have enough redundancy to correct too many errors, and the DATV receiver screen will go blank or freeze.

The FEC algorithms used in the DVB-S2 protocol are different that those used in the older DVB-S and DVB-T protocols. The DVB-S commercial television standard uses a first FEC algorithm called the inner-Punctured-Convolutional-Code encoding specification and then decoded by Viterbi. The second FEC algorithm is called Reed-Solomon. Combining the Convolutional encoding with Viterbi decoding is an FEC technique that is well suited to a channel in which the transmitted signal has been corrupted by Gaussian noise.

The DVB-S2 FEC specification originated with the desire for improved efficiency. In DVB-S2, the DVB-S inner convolutional coding has been replaced with Low Density Parity Check (LDPC) coding and the DVB-S Reed-Solomon encoding is replaced with the Bose-Chaudhuri-Hocquenghem (BCH) algorithm for outer encoding.

The inner LDPC FEC algorithm can be configured for different levels of error correction. These different redundancy settings are usually called: 1/2, 3/5, 2/3, 3/4, 5/6, 8/9 and 9/10. (See Table 2) Where, the first number ("1" in the case of configuration 1/2) is the number of input bits. The second number ("2" in the case of configuration 1/2) is the number of output bits from this FEC algorithm. In the case of "1/2", the data "inflation rate" is 100%.

FEC	QPSK	8PSK	16APSK	32APSK
1/4	Optional	No	No	No
1/3	Optional	No	No	No
2/5	Optional	No	No	No
1/2	Yes	No	No	No
3/5	Yes	Yes	No	No
2/3	Yes	Yes	Optional	No
3/4	Yes	Yes	Optional	Optional
4/5	Yes	No	Optional	Optional
5/6	Yes	Yes	Optional	Optional
8/9	Yes	Yes	Optional	Optional
9/10	Yes	Yes	Optional	Optional

Table 2 FEC rates for DVB-S2 Broadcasts

The second algorithm that is used is the BCH FEC algorithm produces a variable length overhead. It adds an overhead of typically 192 bits to a long data body frame for the FECFRAME length of 64,000 bits. Its data stream "inflation rate" is very small, typically around 0.5% or less depending on the FEC Rate (see Table 3 for exact values).

FEC Rate	Frame lengths	CR_{BCH}
1/4	16,008 / 16,008 + 192	0.98815
1/3	21,408 / 21,408 + 192	0.99111
2/5	25,728 / 25,728 + 192	0.99256
1/2	32,208 / 32,208 + 192	0.99407
3/5	38,688 / 38,688 + 192	0.99506
2/3	43,040 / 43,040 + 160	0.99630
3/4	48,408 / 48,408 + 192	0.99810
4/5	51,648 / 51,648 + 192	0.99630
5/6	53,840 / 53,840 + 160	0.99704
8/9	57,472 / 57,472 + 128	0.99778
9/10	58,192 / 58,192 + 128	0.99780

Table 3 Value of BCH "inflation" for 64,800-bit Frame

Digital Modulation Symbols and Symbol-Rates

Digital modulation technologies like BPSK (an example is PSK-31), QPSK (Quad Phase Shift Keying), 8PSK and 32APSK (Amplitude and Phase Shift Modulation with 32 "constellation points") have the ability to put more information into a more narrow frequency spectrum than analog modulation. The complexity of the digital modulation scheme, allows us to pack more "data bits" into each SYMBOL. Table 4 lists out how many data bits can be packed into a symbol for several well known digital modulation technologies.

The higher-order modulations schemes, like 16APSK and 32APSK, can "pack" more bits into the symbol rate than

Modulation Scheme	Data Bits per Symbol (Me)
BPSK	1
GMSK	1
QPSK	2
8-VSB	3
8PSK	3
16APSK	4
QAM16	4
32APSK	5
QAM64	6
QAM256	8
256APSK	8

Table 4 Symbol Bit-Packing for Various Digital Modulation Technologies (Modulations in BLUE can be selected for DVB-S2) (Modulation in GREEN is an example of option added by recent DVB-S2X)

QPSK. But, the complexities for 16APSK and 32APSK modulation make them more susceptible to noise and interference than QPSK. The DVB-S2 protocol provides for QPSK, 8PSK, 16APSK, and 32APSK (marked in BLUE in Table 4). See later section on the newer DVB-S2X standard for additional modulations schemes that were added like 256APSK (marked in GREEN in Table 4). The drawings in Fig 2, Fig 3, Fig 4, and Fig 5 are intended to give an appreciation of the increasing complexities for these modulation schemes.

Notice in Fig 4 and Fig 5 that not only is the angle from the origin to the state important, but the amplitude from the origin is critical, also.   Think of APSK as a digital modulation that is similar to QAM modulations...but providing a circular constellation.

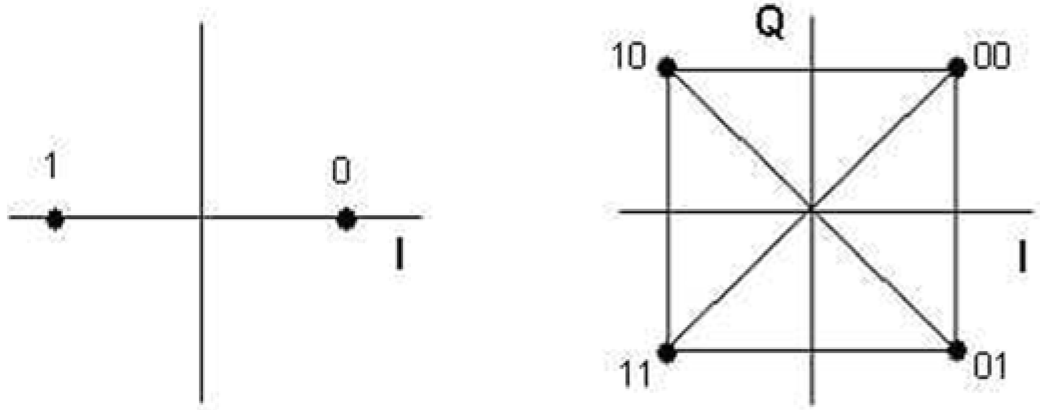


Figure 2 The constellations of BPSK (on the left, think PSK31) with two states and by QPSK with four states.

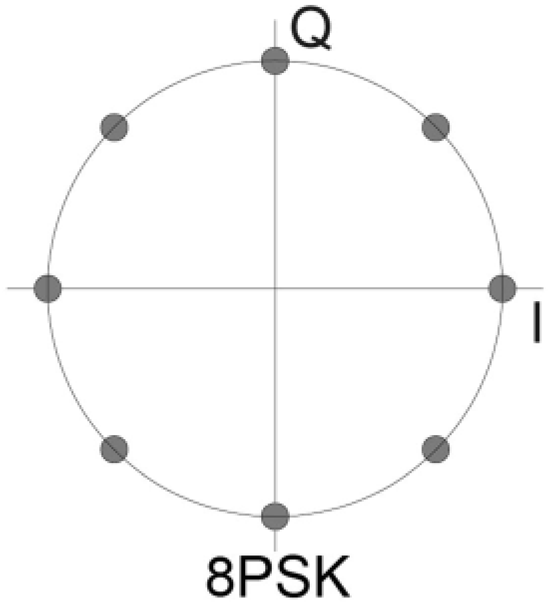


Figure 3 The constellation for 8PSK modulation contains 8 states. Each state defines three bits of data.

Hans DC8UE in Hamburg has conducted DATV testing that compares DVB-S2 to DVB-S. When he tests with DVB-S

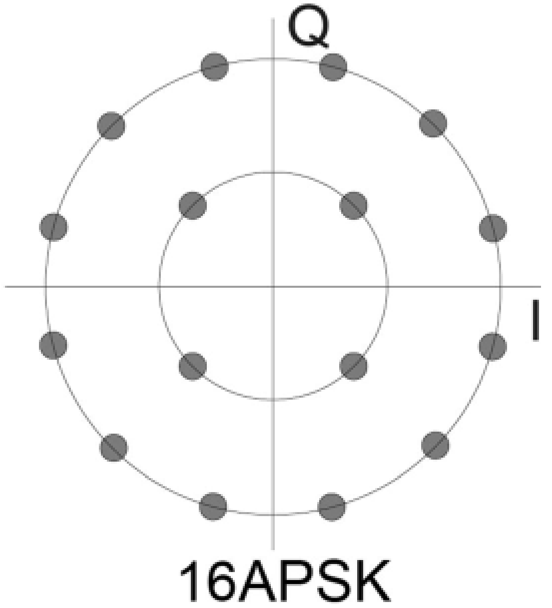
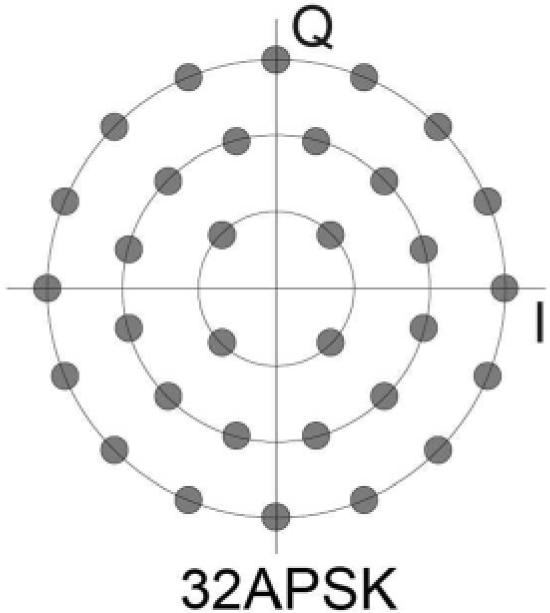


Figure 4 The constellation for 16APSK modulation contains 16 states. Each state defines four bits of data.



(QPSK with FEC equal 1/2) he needs the signal to be 5.5 dB above the noise (C/N). With DVB-S2 QPSK (FEC = 1/2) he needed C/N = 2.2 and with 8PSK (FEC = 3/5) he needed C/N = 6.5. Clearly the more complicated 8PSK modulation is more susceptible to noise.

For commercial DVB-S2 satellite broadcasting, only the QPSK and 8PSK modulations are currently being used. Stefan DG8FAC of SR-Systems explains that commercially, "16APSK and 32APSK modulations are only for Ground Links [and for portable Uplinks] at the moment". I do not know of any ham DATV installations that are currently using 16APSK or 32APSK modulation.

DVB-S2 Bandwidth

Table 4 shows for example that 8PSK modulation technology will pack three data bits into each symbol being modulated. If we know the final output data-bit-rate (I will call this inflated data rate the "Gross Data-Bit-Rate") that we need for the television signal, then the "symbol-rate" we need is exactly one-third of that gross data-bit-rate. That is: each symbol will produce three bits of data.
For example:

Gross Data-Bit-Rate = 4.5 Mbits/sec

Symbol-Rate Needed = 1.5 MSymbols/sec (for 8PSK)

The formula to calculate the Symbol-Rate setting that is needed for a DVB-S2 transmitter is:

Symbol-Rate Needed = NDBR / (Me x CRLDCP x CRBCH)

Figure 5 (Left) The constellation for 32APSK modulation contains 32 states. Each state defines five bits of data.

Where:

- *NDBR= Net Data Bit Rate (aka the information rate - sometimes called the "payload" data rate)*

  Same as MPEG-2 output data rate in Fig 1
- *Me = Modulation Efficiency (3 for 8PSK in Table 4)*
- *CRLDPC = Correction Rate setting for LDPC (1/2, 3/4, etc)*
- *CRBCH = Correction Rate value for BCH found in Table 3*

I will now calculate an example for 8PSK modulation where the output of MPEG-2 encoder is 2.4 Mbits/sec and the FEC rate is set to a value of 3/5.

- *Symbol-Rate Needed =2.4 Mbit/sec 3 bits/symb * (3/5) * (0.99506)*
- *Symbol-Rate Needed =2.4 Mbit/sec 1.791 bits/symb*
- *Symbol-Rate Needed =1.34 Msymbols/sec*

The final formula is for DATV Bandwidth (BW). The "roll-off" factor affecting BWallocation for DVB-S2 is 0.2; compared to DVB-S where roll-off is 0.35. For DVB-S2 modulations, the formula for (allocation) RF BW is:

RF BWallocation = 1.2 x Symbol-Rate

Fig6 shows a spectrum analyser capture of a 1.2 GHz DVB-S2 signal, using 8PSK modulation (13.5MSymb/sec, FEC=3/5, Pilots ON, RollOff = 20%). The Bandwidth shown is about 16.2 MHz.

Fig7 shows a constellation analyser screen capture of DVB-S2 transmission using the 16APSK modulation. Note that DATV-Express has tested, but not released DVB-S2 capabilities - mainly because of complex licensing issues.

The Net-Data-Bit-Rate (NDBR) is the "payload" bit rate

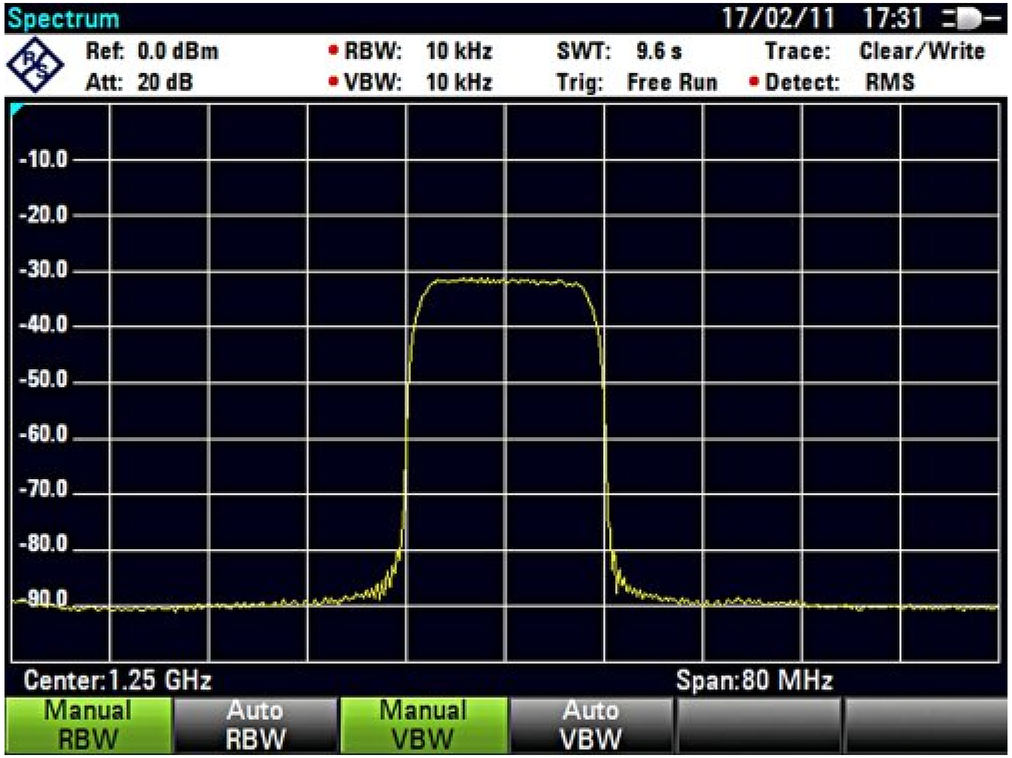


Figure 6 A DVB-S2 MidiMOD2 exciter 8PSK output transmission is seen on a Spectrum Analyzer with BW = 16.2 MHz (Courtesy of Stefan DG8FAC)

needed for the video and audio streams. The Net-Data-Bit-Rate capacity that can be supported in a particular bandwidth is listed in Table 5. Note that these values do not include the overhead introduced by inserting Pilot Tones for improved receiving robustness.

Receiving DVB-S2

In Fig 1, the block diagram shows a typical DVB-2 receiving station used for DATV. The DVB-S2 SetTopBox (STB) can be purchased on e-bay and other online stores here in the USA. The output ports of many DVB-S2 STB's include: composite video, S-video, component video, and HDMI interfaces. It is

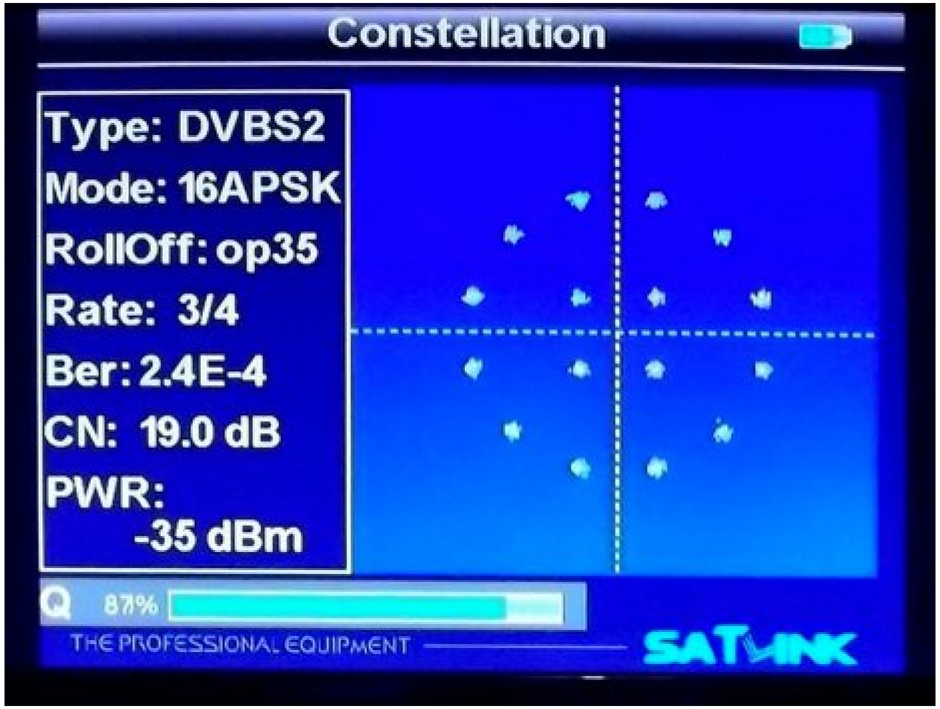


Figure 7 â€“ Constellation of a DATV-Express exciter testing DVB-S2 with 16APSK modulation (Courtesy of Charles G4GUO)

Modulation	FEC Coderate	DVB-S2 RF BANDWIDTH for DATV (RF BW = SymbolRate x 1.2)						
		1.5 MHz (SR = 1.25 MS/sec)	2.0 MHz (SR = 1.67 MS/sec)	2.5 MHz (SR = 2.08 MS/sec)	3.0 MHz (SR = 2.5 MS/sec)	4.0 MHz (SR = 3.33 MS/sec)	5.0 MHz (SR = 4.17 MS/sec)	6.0 MHz (SR = 5.0 MS/sec)
QPSK	1/4	0.62	0.83	1.03	1.24	1.65	2.06	2.47
	1/3	0.83	1.10	1.37	1.65	2.20	2.76	3.30
	2/5	0.99	1.33	1.65	1.99	2.64	3.31	3.97
	1/2	1.24	1.66	2.07	2.49	3.31	4.15	4.97
	3/5	1.49	1.99	2.48	2.99	3.98	4.98	5.97
	2/3	1.66	2.22	2.76	3.32	4.42	5.54	6.64
	3/4	1.87	2.50	3.11	3.74	4.99	6.24	7.49
	4/5	1.99	2.66	3.32	3.99	5.31	6.65	7.97
	5/6	2.08	2.78	3.46	4.15	5.53	6.93	8.31
	8/9	2.22	2.96	3.69	4.43	5.91	7.40	8.87
	9/10	2.25	3.00	3.74	4.49	5.98	7.49	8.98
8PSK	3/5	2.24	2.99	3.73	4.48	5.96	7.47	8.96
	2/3	2.49	3.33	4.14	4.98	6.64	8.31	9.96
	3/4	2.81	3.75	4.67	5.61	7.48	9.36	11.23
	5/6	3.12	4.16	5.18	6.23	8.30	10.39	12.46
	8/9	3.33	4.44	5.53	6.65	8.86	11.10	13.30
	9/10	3.37	4.50	5.60	6.74	8.97	11.23	13.47
16APSK	2/3	3.32	4.43	5.52	6.63	8.84	11.07	13.27
	3/4	3.74	4.99	6.22	7.47	9.95	12.46	14.94
	4/5	3.99	5.33	6.64	7.98	10.64	13.32	15.97
	5/6	4.15	5.55	6.91	8.31	11.07	13.86	16.62
	8/9	4.43	5.92	7.38	8.87	11.81	14.79	17.74
	9/10	4.49	6.00	7.47	8.98	11.96	14.98	17.96

Table 5 Net Data Bit Rates (NDBR) for DVB S2 at a given bandwith

interesting to note that the DVB-S2 STB usually will receive old DATV DVB-S transmissions using a "modified 8PSK mode" setting that is backward-compatible to DVB-S.

Newest Optional Standard - DVB-S2X

In March of 2014, the Digital Video Broadcasting standards group (DVB) released a new protocol standard called DVB-S2X, which is an optional extension to the DVB-S2 standard. The main goals of the DVB-S2X standard are:

Very Low SNR operation support down to -10 dB SNR

Add new Modulations schemes: 64APSK, 128APSK, and 256APSK

Add two smaller roll-off options of 5% and 10% (in addition to 20%, 25% and 35% in DVB-S2)

"Channel Bonding" to allow up to three transponders to become a logical TS for forth-coming UHDTV (Ultra High Definition) satellite transmissions

The new DVB-S2X extension standard goes a long way to make transmissions even more robust. This protocol "hugs" very close to the Shannon limit of spectral efficiency. This new DVB-S2X spec is called optional, and the DVB organization states that "Such DVB-S2X extensions are non-backwards-compatible with the S2 specification approved in 2004, and are optional for the implementation of new receivers under the S2 specification". My view of the world is

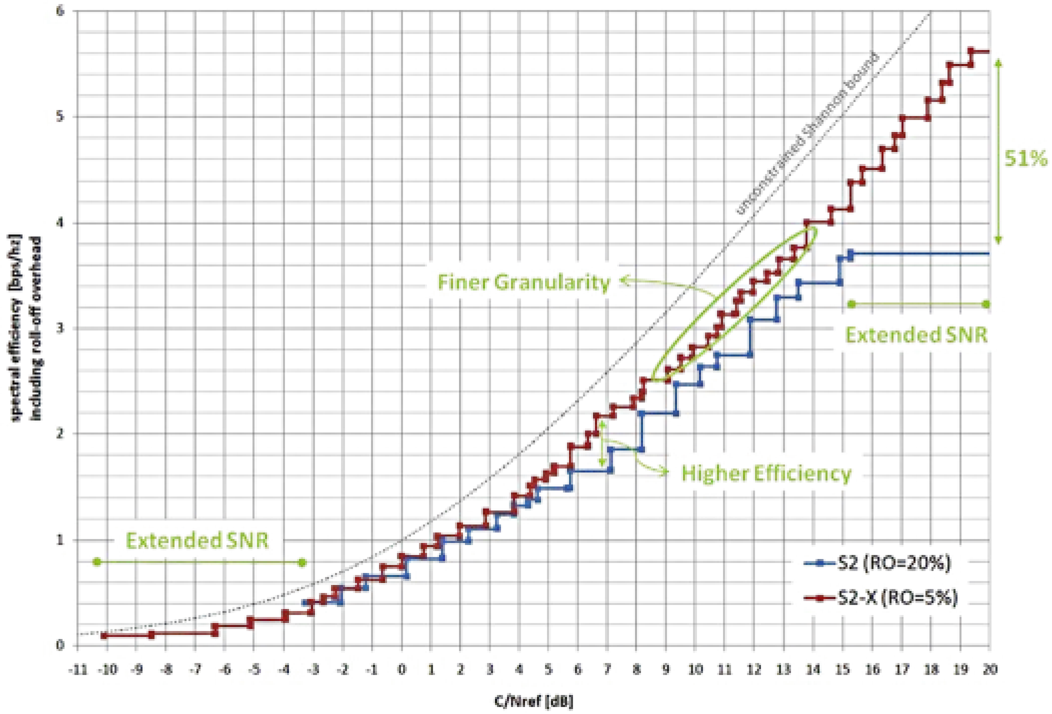


Figure 8 Graph comparing new DVB-S2X (RED) performance and older DVB-S2 (BLUE) against the "Shannon limit"

that "technologies keep on changing, usually getting better".

Comparing DVB-S2 with DVB-S

Table 6 attempts to compare the strengths and weaknesses (PROs and CONs) of DVB-S2 against DVB-S for Digital-ATV. There is no question that DVB-S2 provides a more robust signal and can pack multiple TS video streams into a small bandwidth. Earlier DVB-S2 STB's (around 2010) were reported to not be capable of receiving Symbol Rates less than 10 MSymbols/sec. But this Symbol Rate limitation is no longer true. Also G4GUO reports he uses PC-based DVB-S2 receivers and that most of them will operate at our low symbol rates.

	DVB-S2	DVB-S
PROs	Quasi-Error-Free operation at about 0.7dB to 1 dB from the Shannon limit 1xTS Bandwidth can be as small as 1 or 1.5 or 2 MHz with 8PSK The protocols allows use of MPEG-4 (H.264) comrpession standard that can reduce the payload data-stream by almost 50% Cheap Set Top Boxes (STB) on eBay and online 3 MHz bandwidth can support multiple video streams	1xTS Bandwidth can be as small as 2 or 3 MHz Cheap FTA Set Top Boxes (STB) on eBay Wide-spread experience and knowledge is provided by European hams on the Internet Newer DVB-S2 STB will receive DVB-S
CONs	Currently ham-grade DVB-S2 exciter board is 100% more expensive than DVB-S	QPSK modulation requires larger bandwidth than 8PSK modulation

Table 6 Comparing DVB-S2 with DVB-S

Conclusion

I am not yet convinced that DVB-S2 is the correct technology direction for most ham home D-ATV transmitters. Most new features provided by DVB-S2 technology (like "news gathering" and "data content trunking") are not of much interest to ham DATV. I also do not personally see most hams needing the pixels required by HDTV for DATV uses (think "more pixels equals more bandwidth"). But, the use of the new H.264 video CODEC is a powerful tool for reducing RF bandwidth. My main DATV interest is fitting narrow DATV 1xTS bandwidth into crowded ham band spectrum plans. I can envision placing three 2 MHz DATV repeater signals (or even four 1.5 MHz DATV repeater signals when using 8PSK) into the band space that used to be occupied by a single 6 MHz analog ATV signal. I am certainly impressed that DVB-S2 can provide a great technology for multiple video streams that can be used by DATV repeater operators, such as four

Transport Streams (TS) in a single 6 MHz repeater output transmission.

Contact Info

The author may be contacted at W6HHC@ARRL.net

Useful URLs

British ATV Club - Digital/DigiLite/DTX1 forums - see www.BATC.org.UK/forum/

BATC info site for DTX1 DVB-S exciter - see www.DTX1.info

DATV-Express Project web site (SDR-based exciter) - see www.DATV-Express.com

DigiLite Project for DATV (derivative of the "Poor Man's DATV") - see www.G8AJN.tv/dlindex.html

Digital Video Broadcasting standard for DVB-S2 - see ETSI EN302307-1 specification

Digital Video Broadcasting standard for DVB-S2X - see BlueBook A83-2 / EN302307-2

German portal for DATV streaming repeaters and downloads - see www.D-ATV.net (in German)

Swiss ARALD consortium of ATV repeaters (Amateur Radio ATV La Dôle) - see www.HB9TV.ch

Orange County ARC entire series of newsletter DATV articles - see www.W6ZE.org/DATV/

DG0VE microwave amps, up-converters, down-converters - see www.DG0VE.de

Down East Microwave RF amplifiers - see www.DownEastMicrowave.com

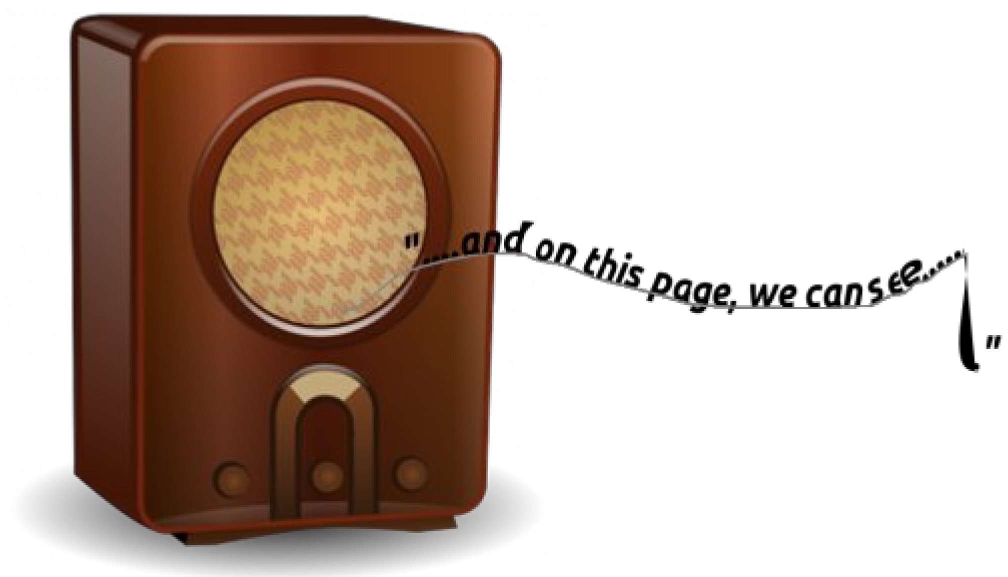
HiDes DVB-T receivers and transmitters - see www.HiDes.com.tw/product_eng.html

SR-Systems D-ATV components (Boards) - see www.SR-systems.de

Wikipedia on DVB-S2 - see http://en.wikipedia.org/wiki/DVB-S2

Wikipedia on H.264/MPEG-4 - see http://en.wikipedia.org/wiki/H.264

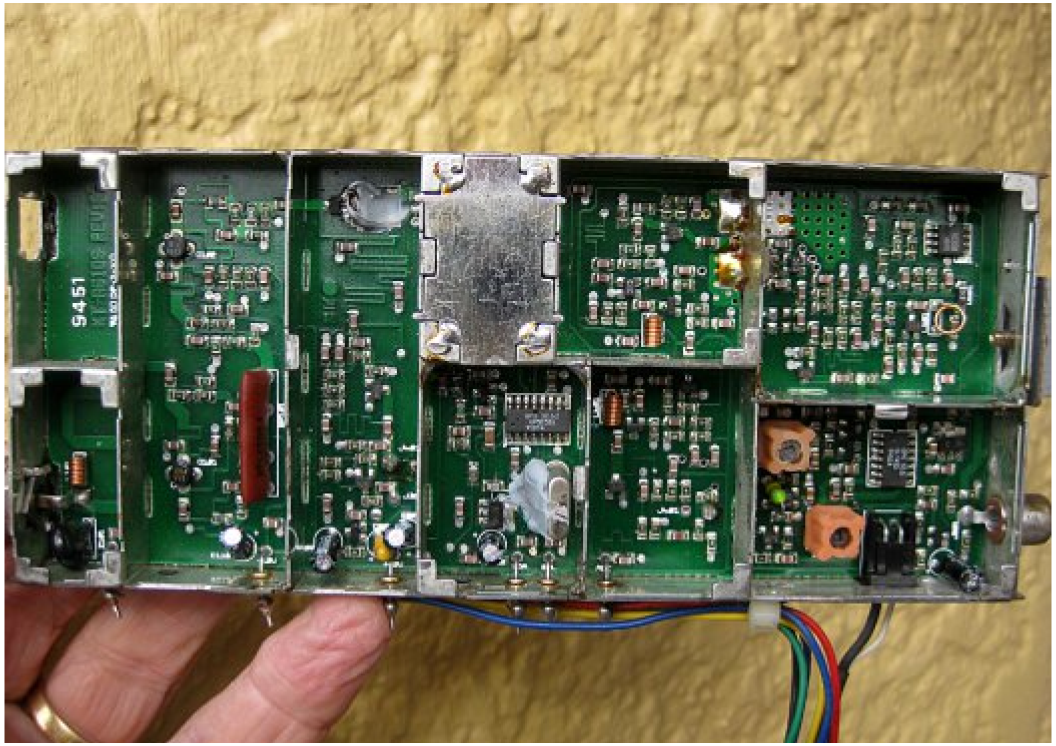
Yahoo Group for Digital ATV - see groups.yahoo.com/group/DigitalATV/



DIGITAL WORLD Part 6

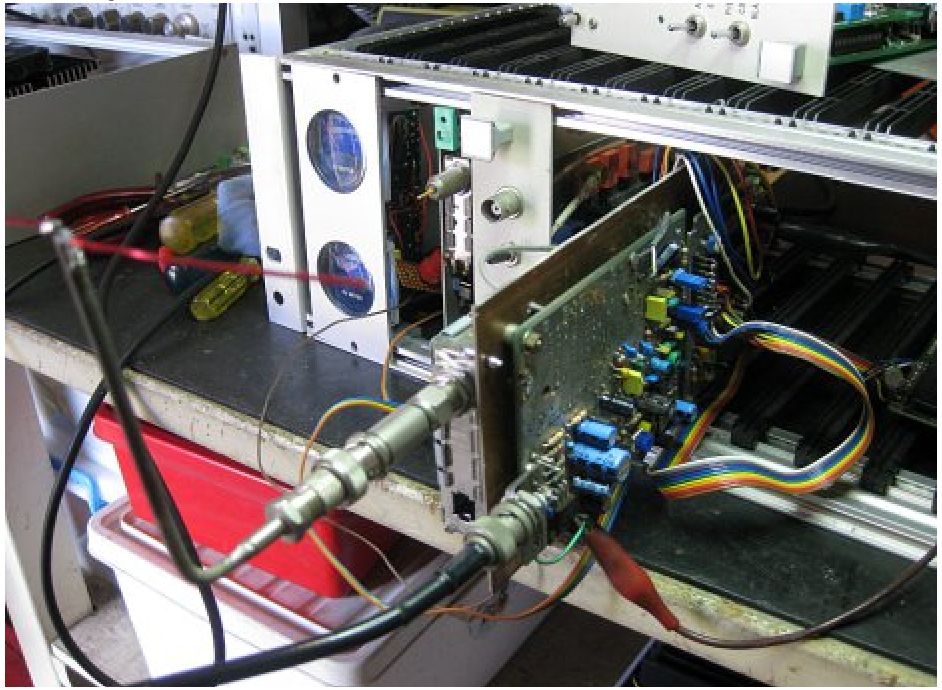
Richard L Carden VK4XRL

In my last article in DATV 12 we looked at the conversion of the Central Receiver from California microwaves. We looked briefly at my first attempt to fit a 23cm receiver onto a normal Rack frame card and also mentioned the use of the BMac receivers for our 23cm reception at our repeater site. During the current upgrade and testing of our spare units two were found to be faulty with no video output. Another problem is that the added audio/video PAL board only has a single sub-carrier demodulator.



BMac reciver

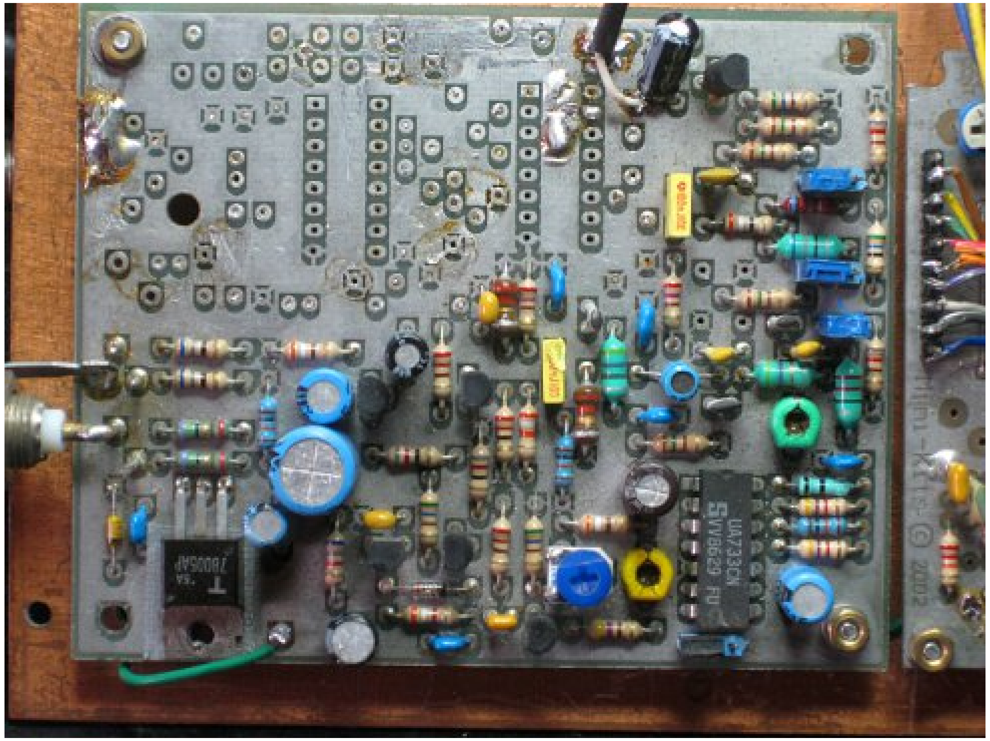
Not that caused any major problems as it was only FM. The video fault was within the BMac board so these units were discarded and the tuner and PAL board removed so I then decided to again have a look at a rack card receiver layout. I decided to use these tuner modules and built a prototype as shown in the photo were you can see that the tuner being rather large was mounted on one side of the rack card.



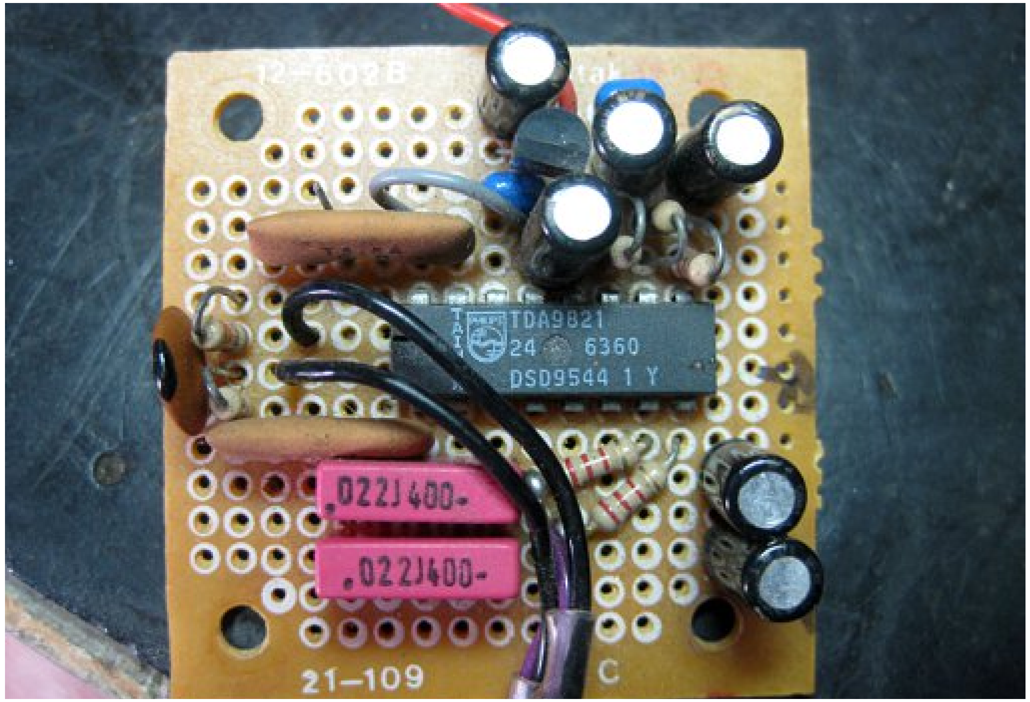
Mounting the receiver and the front end on different sides of a Euro card

I could have used the removed PAL board but it didn't have the video amplifier or output stage fitted and as mentioned before it was only a single sub-carrier demodulator using a LC7215 which I had no control interface circuitry to control it as it was part of the BMac board.

I therefore decided to use a FM board that I had made some years earlier, where the circuit matches closely to those shown on some of the web pages (see Links). The board is relatively straight forward where jumpers are used to switch in the de-emphasis and also to change the video polarity if needed. Also a sub-carrier notch filter can be added by jumper selection.



The PAL section of the BMac RX (not used)



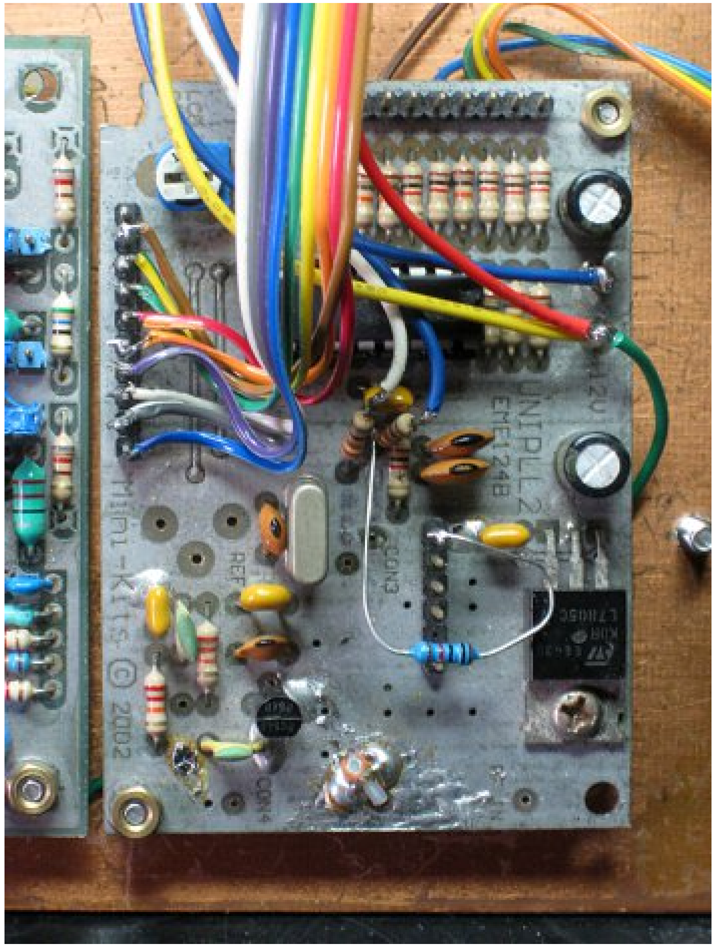
Home Made Option Subcarrier demodulator

However I prefer to use an external video filter of either 5.5MHz or 5.8MHz to remove the sub-carries from the video signal as they are larger than can be fitted to the board. The audio demodulator would be better updated to a dual demodulator IC such as the TDA9820 or TDA9821 and since the board I was using had no audio fitted and having a prototype board available this was then used to check out the complete system concept. Only one other unit was missing and that was the board to provide PLL control for the tuner VCO. For this I used a unit from MiniKits Australia called a wide band PLL. This unit was overkill for want I wanted. I didn't need the readout as we have only two frequencies to worry about so it's hopeful that a simplified PLL can be used in the near future.

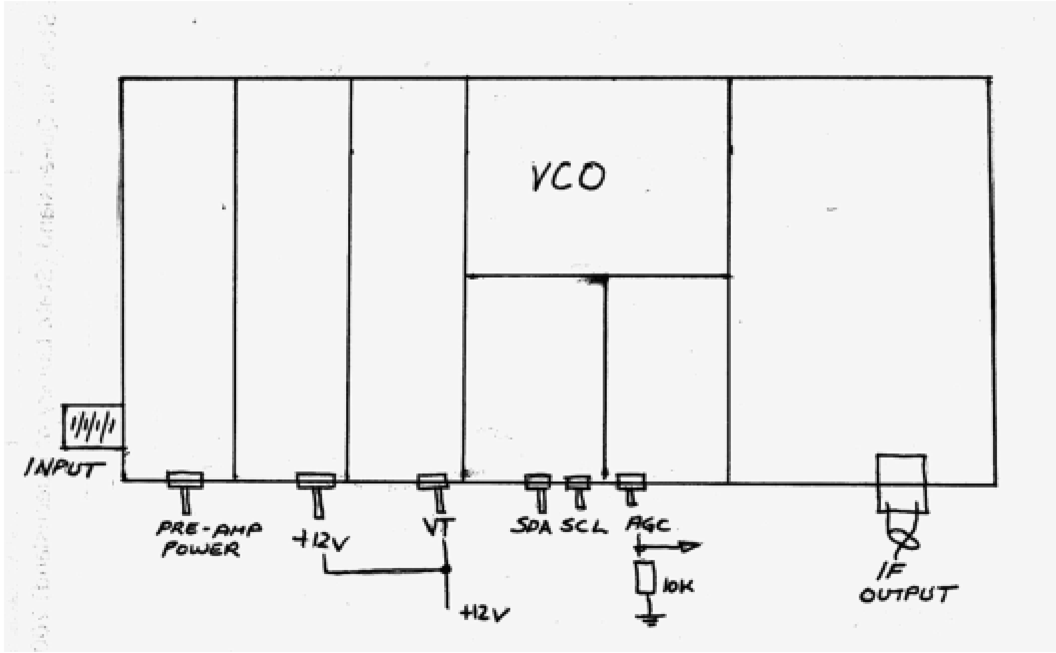
During the setting up of the tuner the offset was found to be around 704 MHz which I found to be rather strange and wasn't any frequency that I have used or read about. The tuner block diagram shows the connections for these tuner modules and the overall block shows you the overall setup of such a completed unit. The 100% colour bars and Mutiburst gives you an idea of what can be expected from the unit.

Where do we go from here? Well it should be possible to make a single sided rack card using the smaller tuners as found in the Comtech receivers or the newer version type BSS479TXIDW which has a variable low threshold demodulator (reference ZL1WTT) and has a switchable IF bandwidth of 18/27 MHz. However it does require a micro to control it.

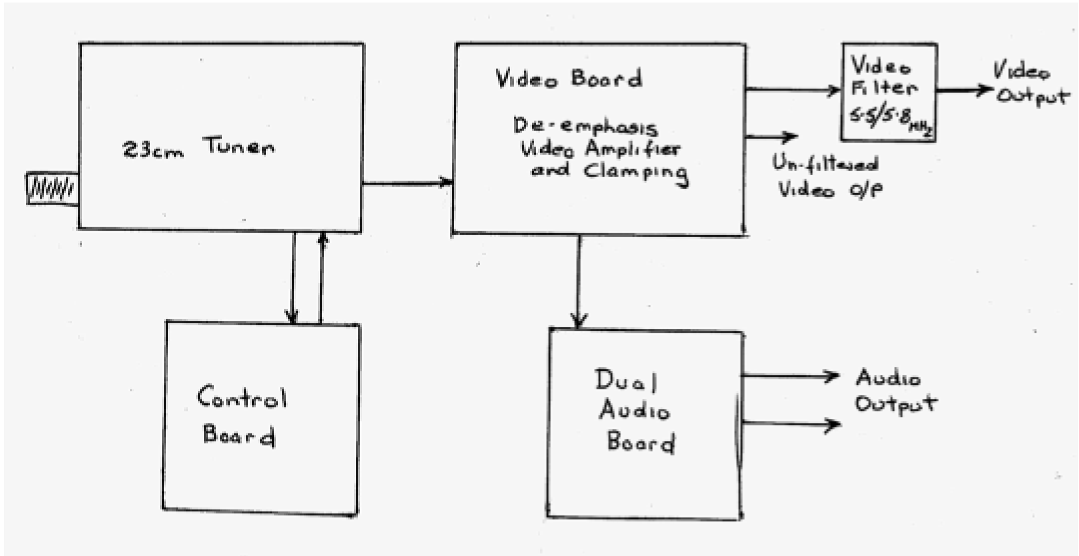
We don't need the readout or the relay switching as most can be set via jumpers and then forgotten apart from the changes required for the required frequency of operation to cater for all uses.



Minikits PLL Module



Tuner module



Receiver block diagram

Links of interest:

http://www.pe1acb.nl/atv.htm

http://pe2bz.philpem.me.uk/Parts-Active/Modules/Sharp-bsfh77g06-SatelliteTuner/bsfh.pdf

http://www.qsl.net/zl1wtt/page4.html

http://www.comtech-tw.com.tw/index.html
(products/BS Tuner)

A Matching System for Two 23 cm Antenna's

Peter Cossins VK3BFG

This technique was derived for matching two 23 cms co-linear arrays for the Melbourne Digital Television Repeater, VK3RTV.

The repeater inputs are 1250 MHz, 1255 MHz and 1278 MHz and the antenna could be pressed into service on any of those frequencies. The co-linear arrays are broadband in their nature and will accommodate the frequency range.

This matching system is not unusual in its concept, but its mechanical construction and control of dimensions is accurate and appropriate for 23 cm work.. The equation below forms the basis of the theory.

$$Z_0 = \sqrt{Z_s \times Z_L}$$

Z0 is the characteristic impedance of the quarter wave matching line, ZS the sending end (antenna) impedance and ZL the load impedance (line impedance).

If ZS is a 50 ohm antenna and ZL is 100 ohms, then Z0 is 70.7 ohms.

Joining two 50 ohm antennas together with their quarter wave matching lines, the result is two 100 ohm loads in parallel making 50 ohms, a match to the line impedance.

This simple network is called a 'Phasing Harness'. (Odd multiples of one quarter wave can be used as well.)

This theory is all well known and used, but the problem with 23 cms is that dimensions become somewhat critical. If you have access to coaxial hardline at the required impedance then this can be used with the length adjusted for the velocity factor of the cable.

The length of cable required can be calculated by ..

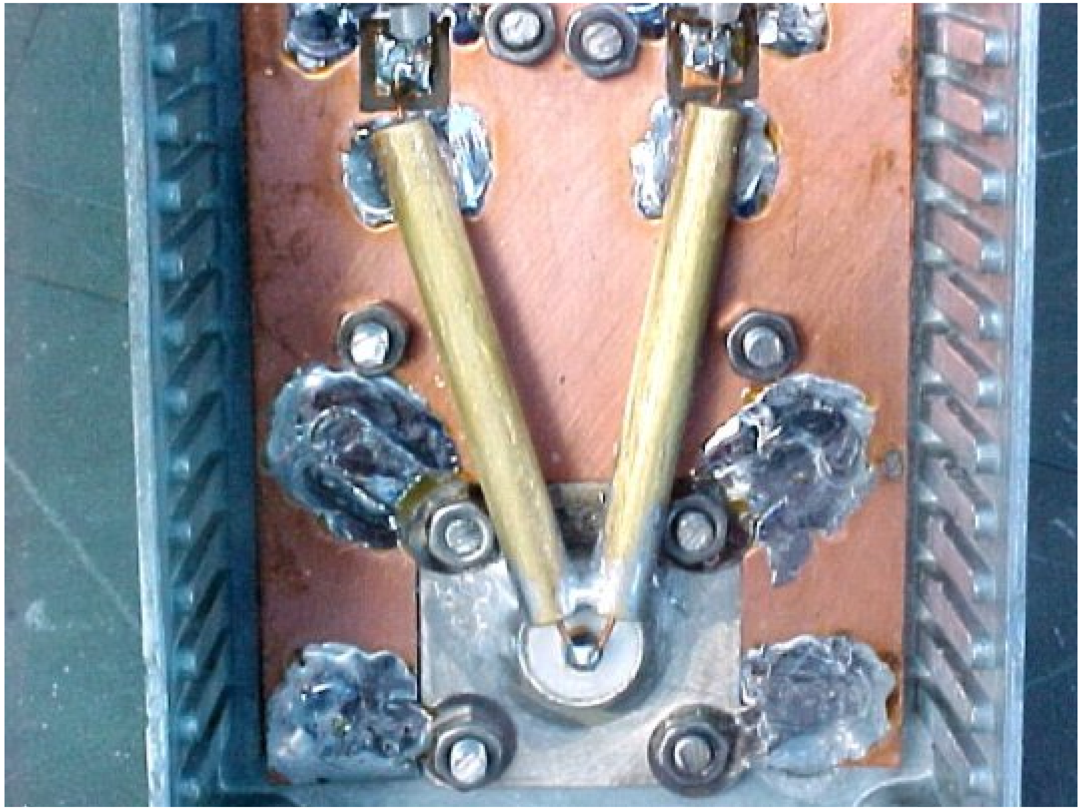
$$\text{Cable Length} = \frac{\text{Velocity Factor} \times 3 \times 10^8}{4 \times \text{Frequency}}$$

This matching system uses standard stock brass tube available from most hobby shops. The diameter I used was 5.5 mm, but it was selected to just fit the inner of 5C-2V, 75 ohm solid dielectric coaxial cable. The inner was obtained by cutting a piece of the cable and removing the outer cover and shield, leaving the insulation and the inner cable intact. The dimensions given in this article are for solid dielectric versions of the cable. If foam dielectric cable is used then the quarter wave lines will be a bit longer to allow for the lower velocity factor. Solid dielectric cable is preferred for this application as it is more robust.

Any suitable 75 ohm cable can be used, with the cable and the brass tube length cut according to the equation above. The brass tube can be accurately cut and filed to the required length, with the main criterion being that the brass tube and the coaxial cable inner form a snug fit. Using 75 ohm cable will provide a satisfactory result as final testing proved.

Referring to the photograph, the components required area silver plated N Connector with Teflon insulation, brass tube to fit the inner of the 75 ohm cable used, double sided PCB, and a 60 by 100 mm approx diecast box. It is advisable to use stainless steel nuts and bolts for durability. The extra cost is absolutely minimal.

Be wary of cheap alternate N Connectors as the insulation in some of these is some form of plastic and will not stand the heat required.



The construction process is as follows...

1. Cut the centre solder terminal of the N Connector down to a maximum of 2 mm in length.

2. Using a mini blow torch, pre solder the N Connector near where the brass tube is to be fixed.

3. Tin the ends of two lengths of 41 mm brass tube. Do not use excessive solder.

4. Join the two brass tubes at one end at an angle of approximately 30 deg using a metal plate to keep the tubes aligned.

5. Jig/lightly clamp the two brass tubes on the pre-soldered N Connector so that they are aligned as they will be in the final assembly. I attached the N Connector to a piece of scrap flat aluminium plate to simulate the PCB ground plane. It is very important to keep all lead lengths to a minimum.

6. Use small gas torch to fill in solder around the N Connector and the brass tube.

7. Strip back the inner of the cable to be used and accurately cut them to length using the brass tubes as a guide. Leave a small length of inner at each end. Put them aside for later use.

8. Pre-drill the diecast box for the N Connector and the PCB groundplane. The N Connector should be at one end of the diecast box facing outwards from the bottom. (Refer to photograph)

9. Recess a piece of double sided PCB so that it fits snugly around the N Connector as in the photograph.

10. Pre-drill the PCB and the die cast box for the six stainless steel mounting bolts.

11. Pre-drill the diecast box on its bottom edge for the two coaxial cable entries and also two moisture holes. The cable entry holes will need to align with the ends of the brass tube.

12. Using the N Connector and the soldered brass tubes as a guide, mark exactly where two lands (insulated connection points) should be etched or cut out. These should be just large enough to terminate the phasing harness cables and the cables from the antenna.

13. Etch or cut out the termination lands on the PCB.

14. Assemble the network using solder lugs to bind the N Connector to the PCB and solder the end of the brass tubes to the PCB groundplane. (Refer to photograph)

15. Insert the RG59 inners and terminate on the N Connector and also to the two PCB lands.

16. The two 23 cms antennas should be fed with equal lengths of 50 ohm cable, fed through the bottom holes of the die cast box and terminated on the PCB lands.

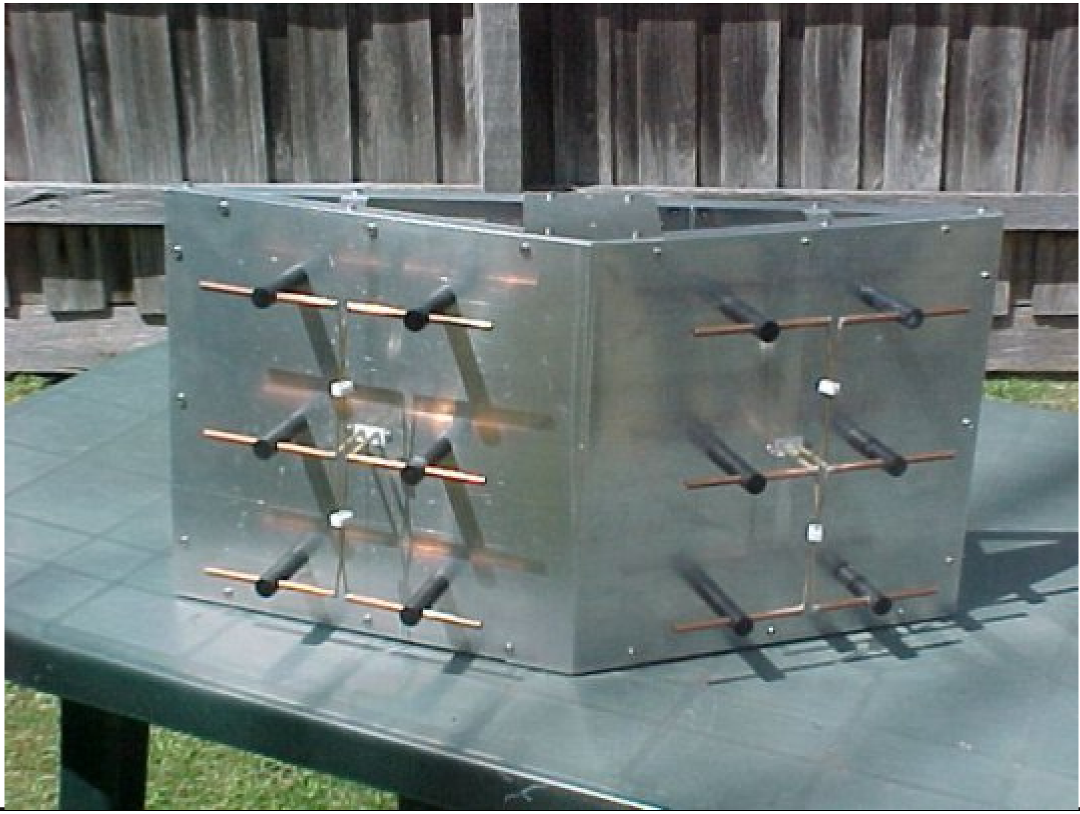
17. Alternatively, two additional N Connectors can be assembled to the diecast box and connected either directly to the ends of the brass sections or by short lengths of 50 ohm Teflon coaxial cable.

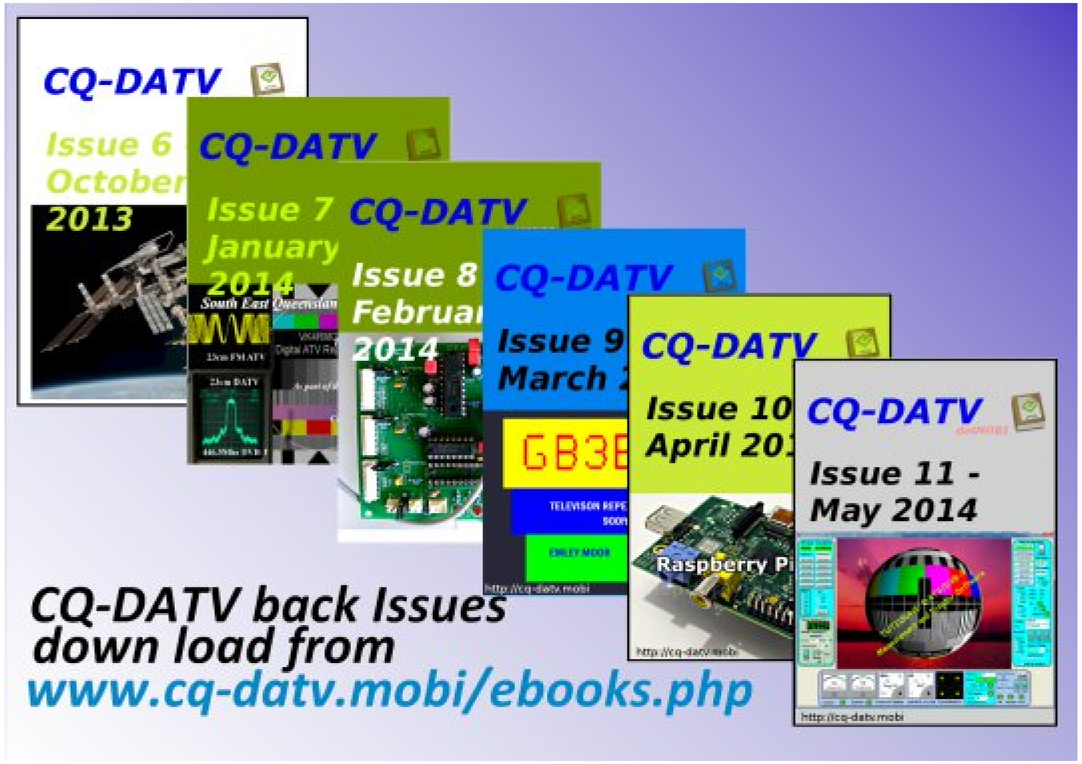
18. Remember to keep leads as short as practically possible with all 23 cms wiring connections. For example, if using the additional N Connectors, the flanges should be pre-soldered and the Teflon coaxial cable outer soldered directly to the flange. A minimal length of inner then makes the connection to the cut down centre pin of the N Connector.

Practical testing of the arrangement using a signal generator, directional coupler and spectrum analyzer with the two brass tube coaxial cable ends terminated using two 100 ohm SMD resistors in parallel on each resulted in a Return Loss of 32 dB.

As most amateurs are unable to measure Return Loss, VSWR measurements are often used. A Return Loss of 32dB represents a VSWR of 1.05:1.

I have built three of these units with almost identical results.





Adding an On Screen Display (OSD) to GB3FY

After Reading the series of articles on OSD in CQ-DATV by Mike G7GTN, it got me thinking of uses for one of these and using it on GB3FY.

We already have a SIGNAL level method, but that requires you to come on with no video and a big bar goes across the screen driven from the AGC trip level.

I have an interest in putting the callsign GB3FY on top of any incoming video plus also on the normal TESTCARD but the difference is it will show the signal below trip point and will allow me to tighten up the trip point under all WX conditions.

I do know from building GB3XG many years ago, the SOLAR noise has a big effect from the peak at about 2pm to a minimum at 4am.

On both Repeaters I do correct and track the NOISE, checking every 10 mins or so providing no-one is using it. Basically it's the SUN that most of it comes from and having an omnidirectional antenna on RX and TX.

So first I obtained one of these MAX chips on a very small PCB and an u/P on it for just under £10 Inc postage. Then later I got another for home use.

Next it has its own character set and this needed to be changed and thanks to MIKE he supplied me with all the information on how to load certain programmes and lots of emails went up and down between us.

Mike has done a lot of work using these devices so he started me off by writing a 'C' program to get me going.

I looked at the hardware and thinking about GB3FY, what do I want after mods to Mikes program. I came up with a long letterbox and at the beginning placed GB3FY. Later on placing two icons I found that look like the Jodrell Bank Astronomy ANT.

Mike told me to get TERA TERM, as it suits using this as an interface from my PC to the OSD.

I soon built a simple PCB where the pins can be soldered on with it upside down. So I added a PIC micro so I could change things without having to keep bringing the repeater back home.This has a standard 5V reg onboard.

So I just send the DATA of the A/D 10 bit value (AGC on the RX) then I can select a lookup table in the PIC and just send a simple number to point in the OSD what CHARACTER LINE to display. I actually have 17. This LINE can be put anywhere on the TV screen. The OSD has 16 lines and 32 Characters across.

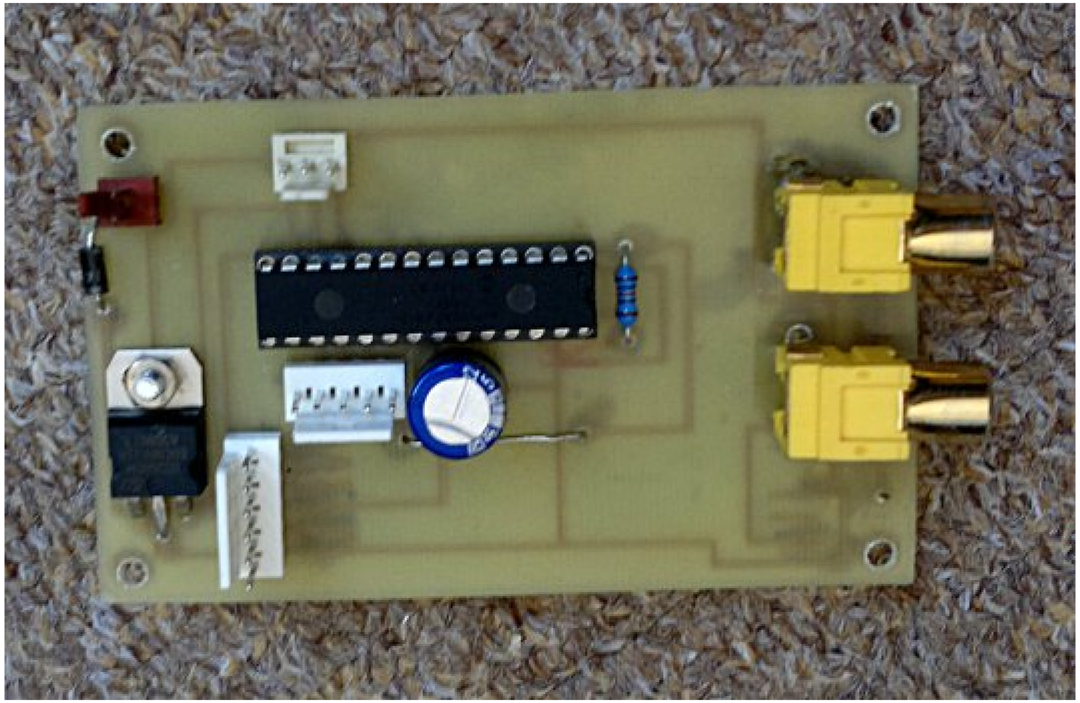
The MAX chip does allsorts like FLASHING, INVERT, BRIGHTNESS and each CELL can have each pixel BLACK, WHITE or TRANPARENT.

See the full character set I used supplied by MIKE. Thanks again

The OSD to the outside world talks in my case 9600 Baud at TTL level and between the PIC and the Repeater the same.

I also needed a Program to be able to talk and download things to the OSD u/P. I am not used to writing in 'C' or using BOOTLOADER programs so its still all a bit new and again Mike dragged me through the learning curve but all good fun.

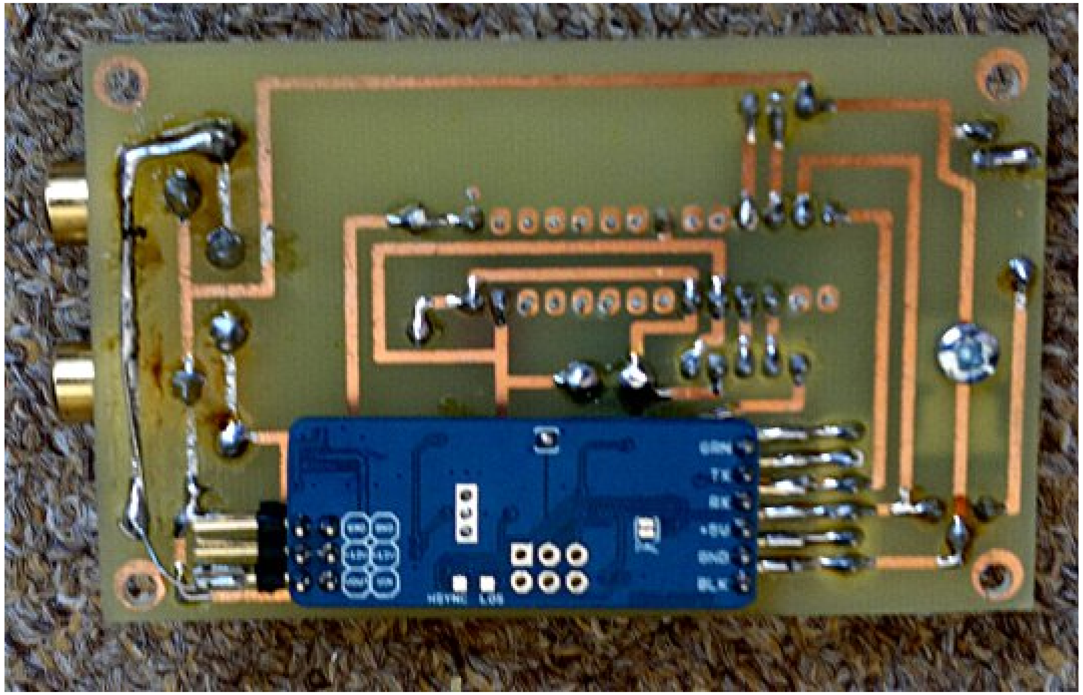
To get the comms to the PIC or OSD, I used one of my standard USB to UART chips. This was explained in an earlier article on other projects. Mike said you can buy these on Ebay, for just a few pounds. A lot cheaper than it cost me to build one.



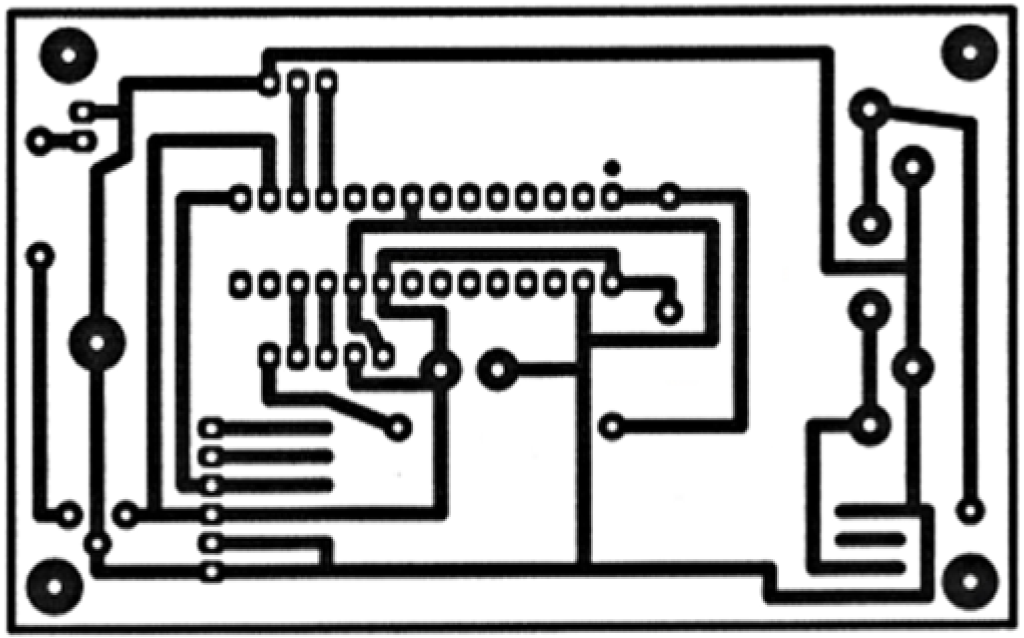
The PCB has Video In ,Video Out Phono sockets
1 2-pin KK power socket 9-13V input
2 3-pin RX/TX comms test PIC UART
3 5-pin KK PIC programming socket
4 6-pin KK OSD interconnection

One thing in the MAX data sheet that I did read was that ALL incoming through Video is Black level clamped on every SYNC line so that's a clean-up bonus for the Repeater. Also the thing will run on its own with NO video input.

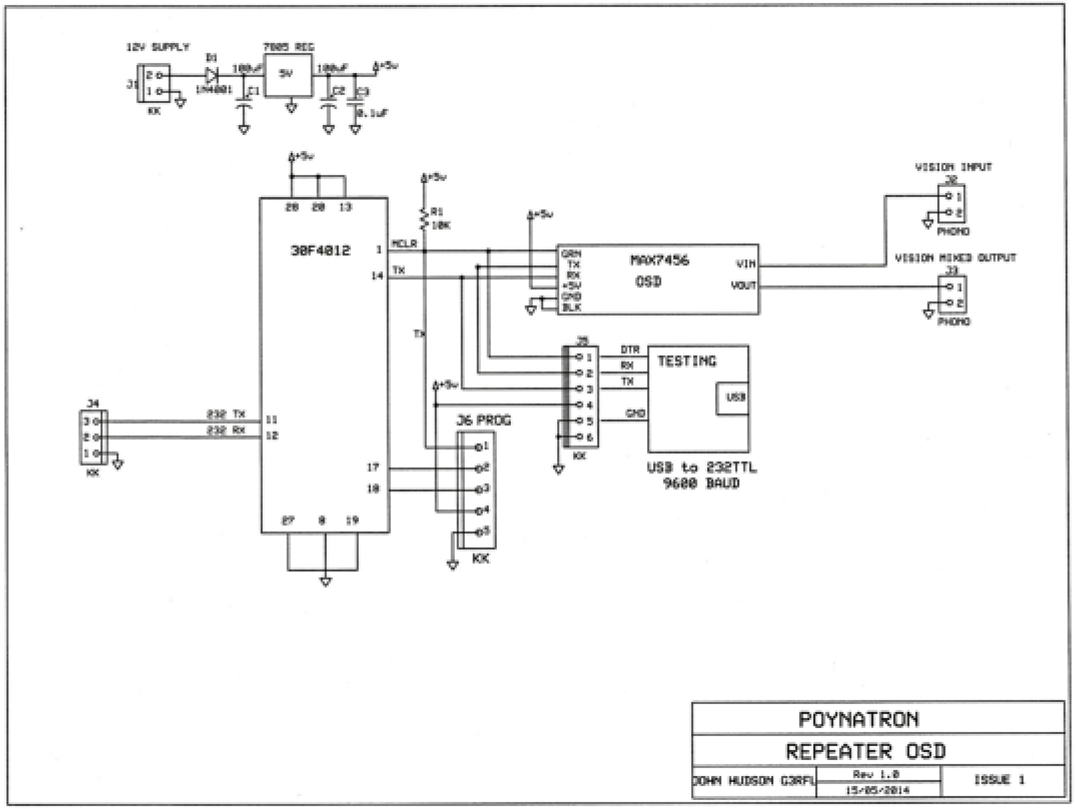
I needed to send the number (not in ASCII) 0 to 17 DEC via the PC to my test PIC and or the OSD after I did Mods to Mike Software in 'C' and learned that CTRL-A to CTRL-Q and CTRL-SPACEBAR gave me all I wanted, 17 and blank.



Bottom of pcb with OSD module fitted



PCB Layout



Without Mike and my Son Lee, this project would have never happened, so thanks LADS.

So we just have to fit it soon.

John G3RFL, Repeater Keeper for GB3FY Fleetwood Lancs

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