

Receiving DATV on four bands with Digital Satellite TV equipment

By Grant VE3XTV

Background:

ATV started out on the 70 cm BAND using AM modulation and all contacts were made via simplex. The receivers were modified UHF tuners pulled down to 439.52 MHz with home made pre-amps. From these experiments it soon became self evident that a repeater was required. With ongoing upgrades over the years and improvements such as a digital input been added, increased RF power and therefore the performance has improved. ATV has become more visible as a mode that could reach out to the public unlike any other. This meant that ATV soon become a good advertisement tool for Ham radio. With these continuing band changes affecting things this has made this area of our hobby very innovative and at the cutting edge technology.

Unfortunately there are a number of down sides to this:

1/ ATV is very much based around home construction, so a basic understanding of electronics is advantage.

2/ The cost factor involved in setting up a transmitter can be a issue for some.

3/ Ham radio operators find change difficult to deal with, they rather walk away then face these ongoing challengers.

In summery change is good for innovation but not for ongoing activity. But mixture of both can provide opportunities that can be explored in our hobby.

With the change over to FM we soon discovered the advantages of this modulation system, this is when we started using Satellite equipment. Currently with the older FM TV there are two ways of receiving signals one is with kit-set board with a L-band tuner module, or the other way is by using a modified analogue satellite set-top box. This is why we have aligned our repeater receive filters for 18MHz channel bandwidth standard, this was done because of the IF of analogue satellite receivers could only be set to 27 or 18MHz. By doing a number of experiments with different bandwidth settings we found that 18MHz provided the best signal to noise performance.

Whereby now digital is the next step in technology in the same way that FM was from AM. This gives us a new area for experimentation such as:

1/ Working with a multiplex configurations

2/ Narrow band signals with low bit rates

3/ HD (1080i) as with the analogue we test a wide range bandwidths up to 18MHz

4/ Video over IP integration and Internet linking possibilities

Equipment for DATV:

As you will see the layout and components are much the same as they were for analogue. For receiving digital signals is not that hard to do, with Freeview receiver coming widely available on market. All bands above 23 cm are using the same digital format as used by Satellite providers DVB-S (QPSK/8PSK). The IF tuner range of these set top box's goes from 950 to 2150 MHz, the 23 cm band is 1240 to 1300 MHz. As you can see the IF range covers this frequency range.



Here is a picture a Strong Satellite Set top box

Satellite in-line amplifiers also can be used as pre-amps with a DC blocker. The noise figure is not that good, it's some where in range of 5 to 6 dBs but this is better no pre-amp.



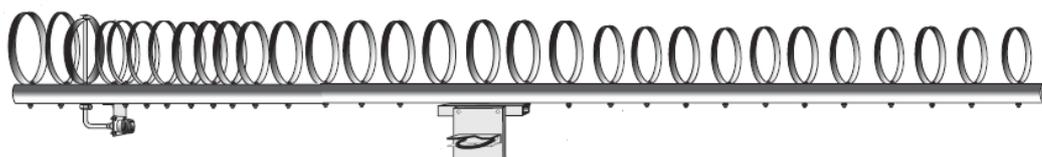
In-line amplifier



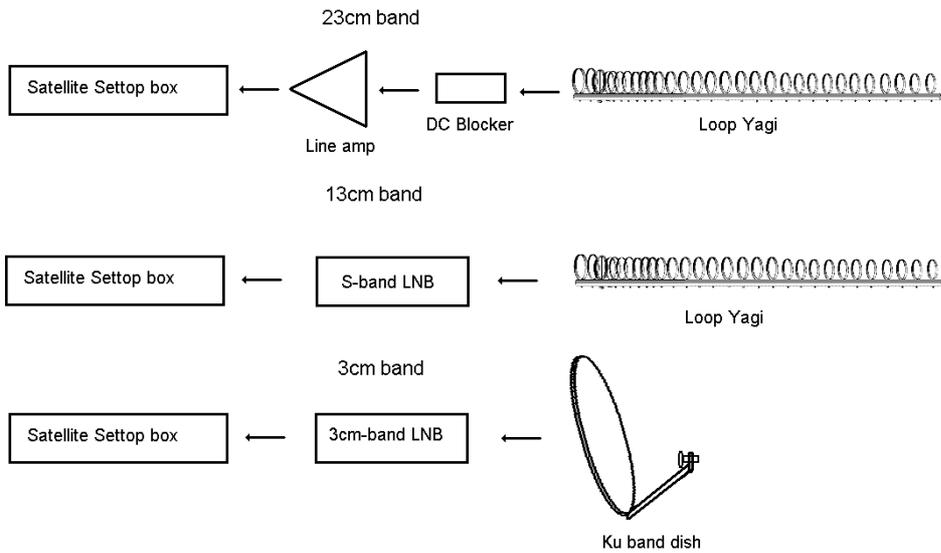
DC-blocking F-connectors

Loop Yagis:

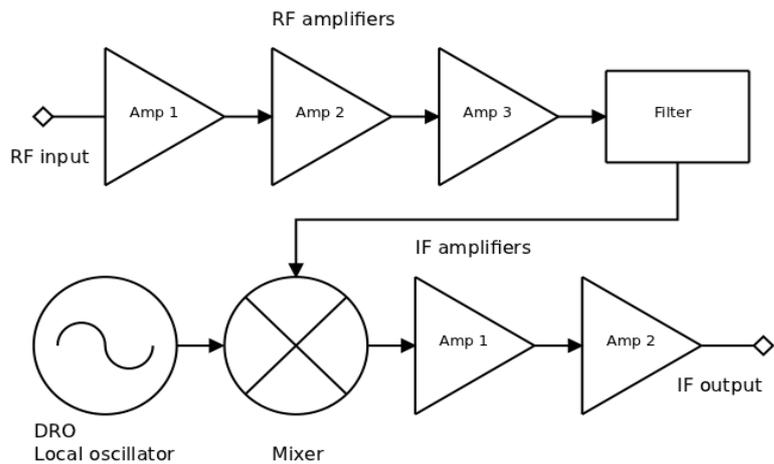
Are used as TX and RX aerials on numbers of bands 23, 13 and 9 cm. A Loop Yagi is nothing more then Quad with round elements. These antennas are made by Directive Systems in kit set form. They can be ordered without booms and can be contracted in less then a couple of hours.



Block diagram layout:



Low noise block layout (LNB):



Receive converters for ATV band I use S, C and Ku band LNB's as below:

13 cm band 2.3 to 2.45 GHz

For this frequency range a S-band LNB can be used with a receive coverage from 2.3 to 2.9 GHz with local oscillator at 3.95 GHz. This band is also used as part of the ISS ATV project as the down link.

IF range 1500 to 1650 MHz

9 cm band 3.3 to 3.41 GHz

C-band LNBs will let you tune outside of the range of this Satellite down link band. They normally have local oscillator at 5.150 GHz

IF range 1650 to 1850 MHz

5 cm band LNB 5.65 to 5.85 GHz

This LNB is a modified S-band unit with local oscillator on the low side at 4.505 GHz and the front end turned for this frequency range.

IF range 1145 to 1345 MHz

3 cm band 10 to 10.5 GHz

With a modified Ku band with a 9 GHz local oscillator, a standard Ku Satellite dish's works very well by mounting this LNB into the feed point.

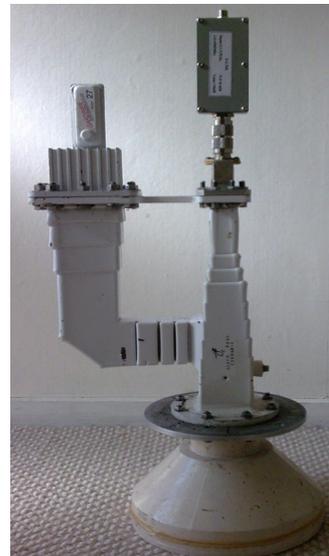
IF range 1000 to 1500 MHz

Experiments:

13 cm band using a Bi-quad dish feed



9 cm and 5 cm dual dish feed



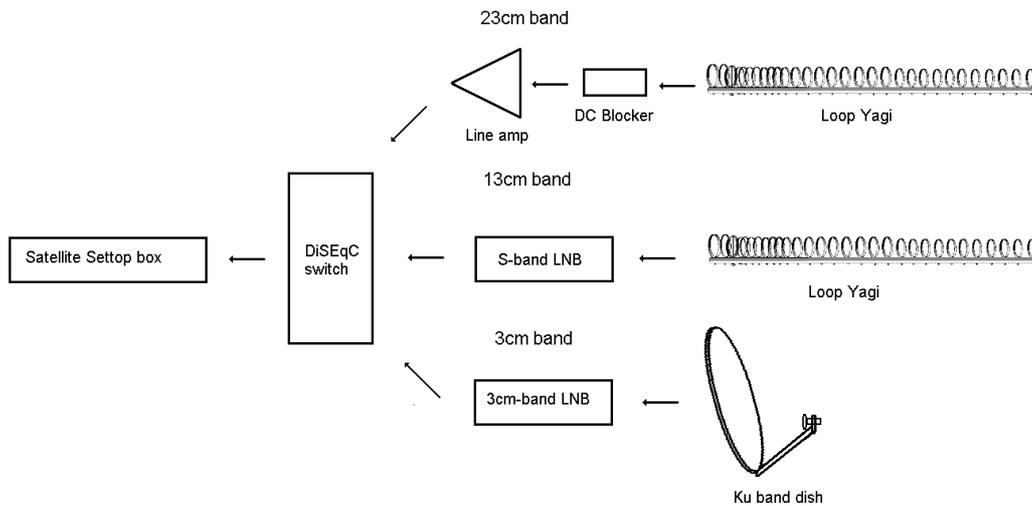
5 cm LNB fitted with wave-guide transition



With this C-band up/down link dual dish feed, where by the frequency used were 3.7 GHz and 6.2 GHz. By testing I found this configuration also works with the Ham bands that fall just below the these Satellite bands. The left LNB is receiving on 5 cm and the one on the right is a C-band LNB receiving on 9 cm. With this dual band feed I can remove the LNBs and connect up to wave-guide via N-type transition for transmitting in to.



DiSEqC switching: Another useful piece of Satellite equipment is a DiSEqC switch, with this device lets you select between four switchable inputs. This can be set up from the menu of most set top boxes and mutable inputs a lot easier. As in the example below.



DATV repeaters:

Inputs:

Our ATV repeater will have a operating inputs on the 23 cm band, one for digital and the other for analog FM. With the option of adding in a extra inputs like 3 cm band link (10 GHz). The receiver layouts above will provide away of receiving simplex contacts, monitoring your home station setup and any repeater outputs in your area on these bands.

Outputs:

Repeater outputs are normally set up in a cross-band configuration this to provide good Receive / Transmit separation. This can be done in many ways such as 13 cm out or even a 3 cm output could be used. Here in the GTA we looking at two possible outputs, one on the 33 cm band 902 to 928MHz and the other on 13 cm, both providing a digital output that can received on most digital set top box's.

This why we have gone with QPSK standard it make setting up a DATV repeater system very simple and inexpensive way to go. With QPSK coming the world standard for DATV, parts and equipment are widely available for DVB-S.

LNB's and Loop Yagis:

Can be obtained off sites like Ebay, there is a good range of C-band models to choose from, S-band and 5cm down converters I have small number left available. As for 3cm models these have been in demand and therefore I will need to reorder more in at later stage.

From this how to guide you can see that it's not hard to receive ATV/DATV with nothing more then a Satellite receiver and satellite equipment, LNB's and the such like.