SATELLITE SWITCHES SIMPLIFIED

Introduction:

Lots of basic switch questions come up every month.
I'm no expert on the subject, but I've been paying close attention to the people who've been putting them to work.
Some have come up with very complicated switching matrices from the simple building blocks.

So, for a while, I've thought we should roll the basics into one document which might answer many of the more common questions.
This weekend, I ran the idea past Iceberg for his input.
We'll try to keep to 22khz (two kinds), diseqc (two kinds), and multiswitches (two kinds, again).
He suggested we don't get into use of bandstacked LNBs, but they could be the basis of another thread, if needed.

Ku band LNBs:

Before talking about switches, it's necessary to understand the more common kinds of LNBs.
Why? Because *some* have built in switching, and that interacts with our external switches.

Standard FTA LNBs deal with one band of satellite frequencies, and have one Local Oscillator frequency (LO).
So, no additional switching is built into the LNB.
These regular FSS, or linear, or FTA LNBs have an LO of 10750mhz.

The DBS (direct broadcast satellite) LNBs for pay TV, have an LO of 11250mhz, and work similarly.
However, the term Standard, is used only for the FTA or FSS band, not pay TV.
So, while for most of the following switch ideas, these LNBs can be interchanged, you have to use the right LNB for the job.

Universal FTA LNBs deal with two bands of satellite frequencies, and have two Local Oscillator frequencies (LO).
To select the higher band (the one we use in North America), you must supply a 22khz tone to the LNB. LO=10600
If you don't, the LNB reverts to the lower of the two LO frequencies and low band (which is useful for Europe and Eastern satellites). LO=9750

As we shall see later, the internal 22khz switch of the Universal LNBs sometimes limit their use.

Singles and Duals

LNBs are further divided into single output and dual output models.
The Singles have one connector, and give the receiver Vertical transponders when fed 12 volts, and Horizontal transponders when fed 18 volts.

The Dual LNBs have two connections which operate as above.
For more complicated switching, you can put one output to 12 volts for Vertical and 18 volts for Horizontal, and get both polarities at the same time.
That feature will be exploited in some of the following designs.

The minute you need to move beyond one LNB, a switch becomes a must.
And since we have to start somewhere, we'll first deal with one-receiver configurations.

22khz switch

This is one of the simplest switches.
It lets you choose between two inputs, based on whether or not a 22khz tone is supplied by the receiver, on the LNB power cable.

Since the tone doesn't pass through the switch, you are pretty much limited to single LO LNBs.
And, there is no chance to cascade a diseqc switch beyond the 22khz switch (the signal doesn't get through from the receiver).
I've picked up these switches for $5, at local swap meets.
They have a reputation for reliable switching, as there are only two states of the 22khz tone: *on* or *off*.

Ecoda 22khz switch is an improved version, which has the capability to pass the solid or pulsed 22khz tone through to the LNBs.
They sell for about twice as much, but considering you might need only one, the cost difference is trivial.
In a later post, we'll get to what you can do cascading the 22khz switches with other kinds.

DISEqC switch

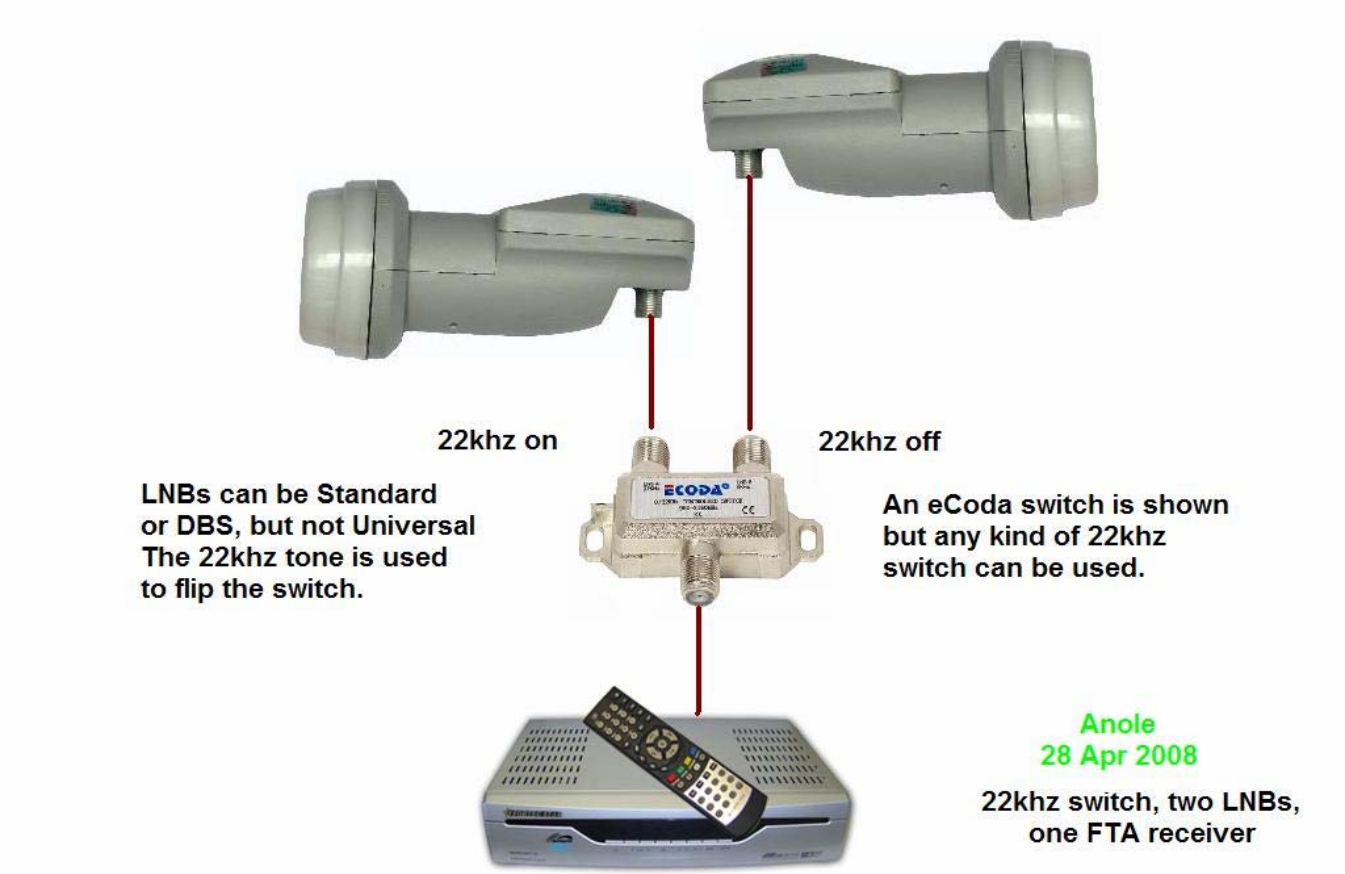
These come in two- and four-input models.
They rely on a 22khz pulse train from the receiver, to select which input is connected to the output.
Generally, they have only a single output, and are designed for one-receiver layouts.
In a later post, well discuss how they can be used in combination with other switches.

These switches are often considered quite delicate, and can fail if connected to powered equipment.
Prices range from 50¢, to $15... but are often in the $5 range.
This is generally the free switch delivered with a new FTA receiver.

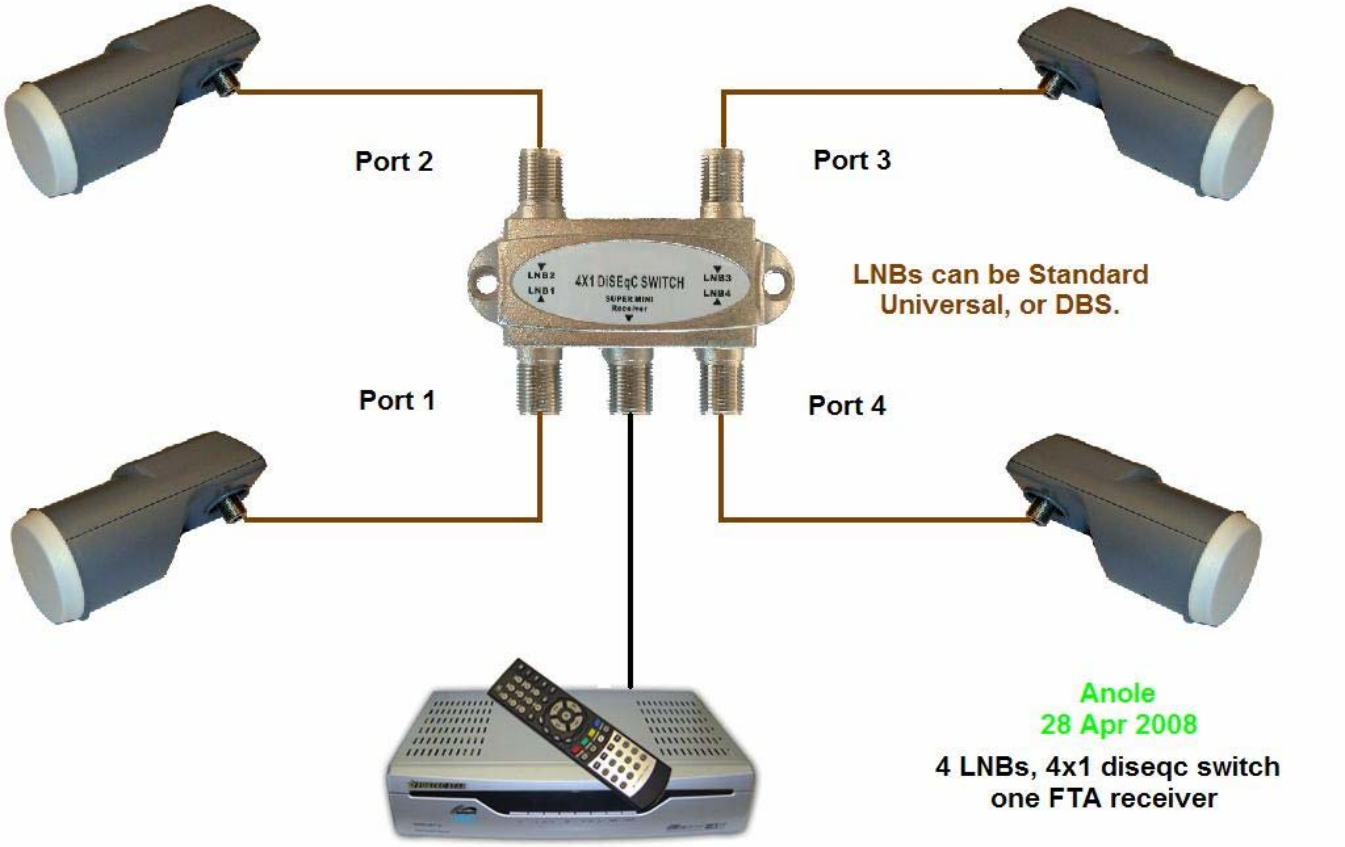
Most models of all switches, do not pass unlimited power.
They'll run other switches and some LNBs, but are probably not suitable for having motors powered from them.
For instance, the Ecoda is rated at 300ma.
Many motors can take that much when under heavy load.

Sample Drawings

Below are two basic examples of the above switches.
While particular brands may be shown, there is nothing special required at this level.



dwg 1: two LNBs, a 22khz switch, and one FTA receiver.



dwg 2: four LNBs, a diseqc switch, and one FTA receiver.

We'll get to more complicated things and other switch types in later installments, but for now, we're focusing on the basics.
These first few posts will be what new visitors read first, so all the more reason they should deal with the simpler switch configs first. -

The drawings are meant to be printed full-page, landscape, on a color printer.
They should have sufficient resolution to be easily read, without being outrageously sized.
You cannot have two 22khz switches hooked in series.
The Universal LNB has a 22khz switch built in.

Let's take dwg #1 above, and assume the external 22kkhz switch is . . .

Traditional 22khz switch
If you used the traditional 22khz switch, it would not pass the tone through from the receiver to the LNB.
So, each Universal LNB would always stay in the Low Band, and select the lower of the two Local Oscillators.
If you had an application where that was useful, then okay.
But, you could not select the high band nor higher Local Oscillator.
For 99% of the birds visible from North America, that would be useless.

Ecoda 22khz switch
The Ecoda 22khz switches do pass along the solid 22khz or tone bursts.
So, the no-tone switch-input would always be selected when there was no 22khz tone from the receiver - leaving that Universal LNB in the low band.
Likewise, the 22khz-input would always be selected when there was 22khz tone from the receiver - placing that Universal LNB in the high band.
Again, if that would be useful, then okay.
However, each LNB would only be selected and left in one mode.

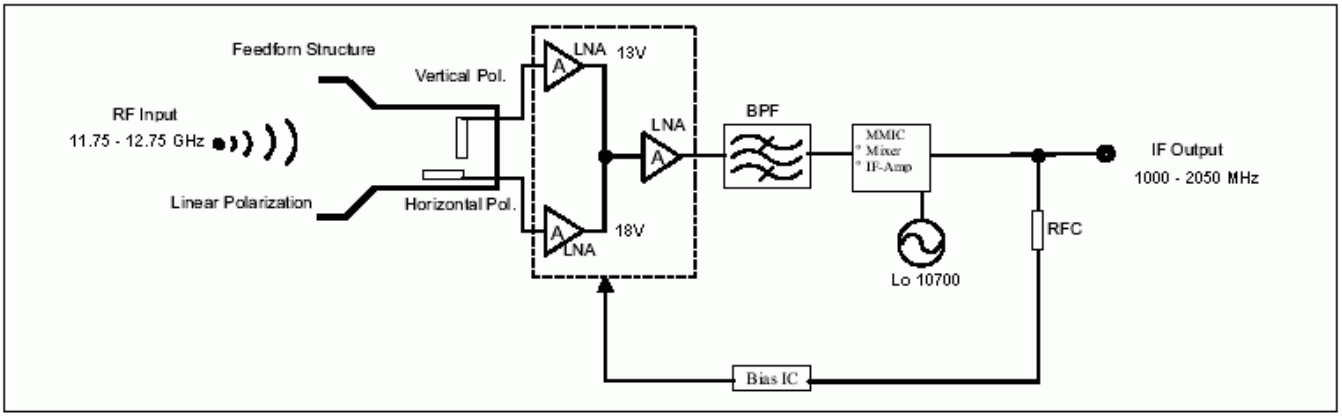
What is hinted at with this arrangement, is that you would be able to put a diseqc switch after an Ecoda 22khz switch, and still get the diseqc to select its inputs.
We can take advantage of this feature in an upcoming sample drawing. . .
. . . once we get to the more advanced configurations.
But first, we'll explore some of the things we can do with what we know so far.

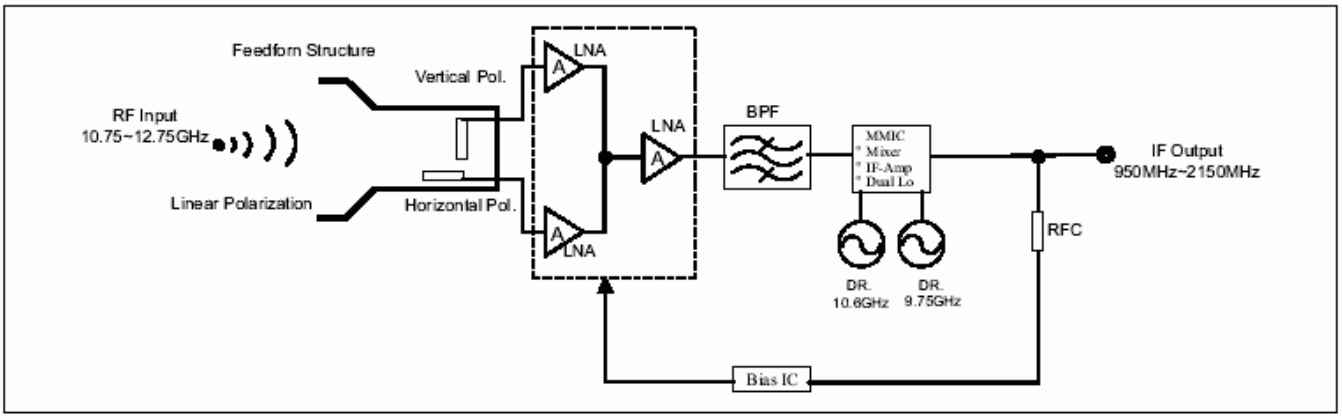
LNB internals
I found these two drawings, and kept them for future reference.
I'd be happy to give the web page I took them from, but sometimes that info doesn't get saved.

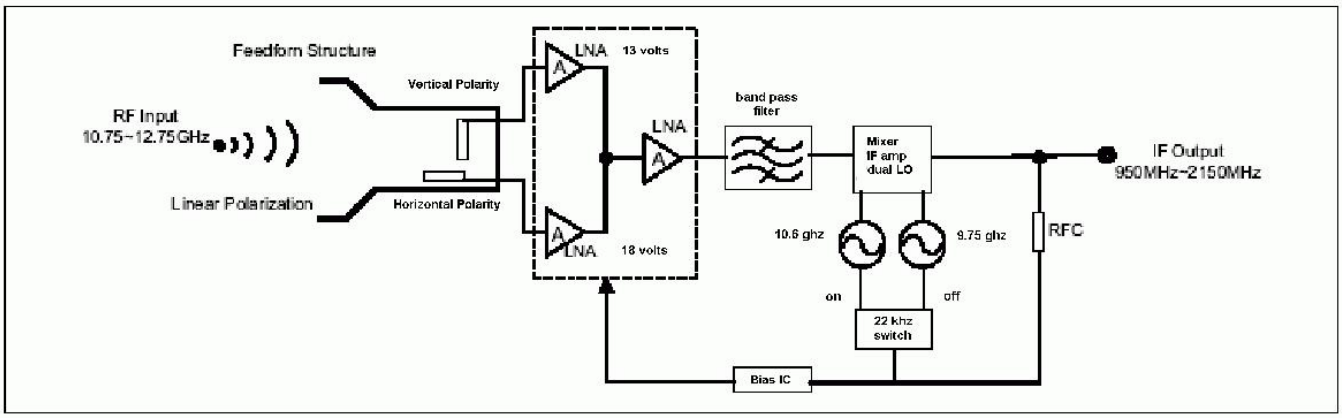
They are block diagrams of the internal workings for Standard and Universal LNBs.
In the Standard, there is only one LO, and the 12/18 volts selects Vertical/Horizontal polarity, respectively.

In the Universal, there are two LOs selected by a 22khz switch that isn't shown, and then 12/18 volts selects Vertical/Horizontal polarity, as above.

edit: added a test drawing of the Universal LNB with the 22khz switch shown.
May have to redraw both the pictures, as they are all difficult to read ...



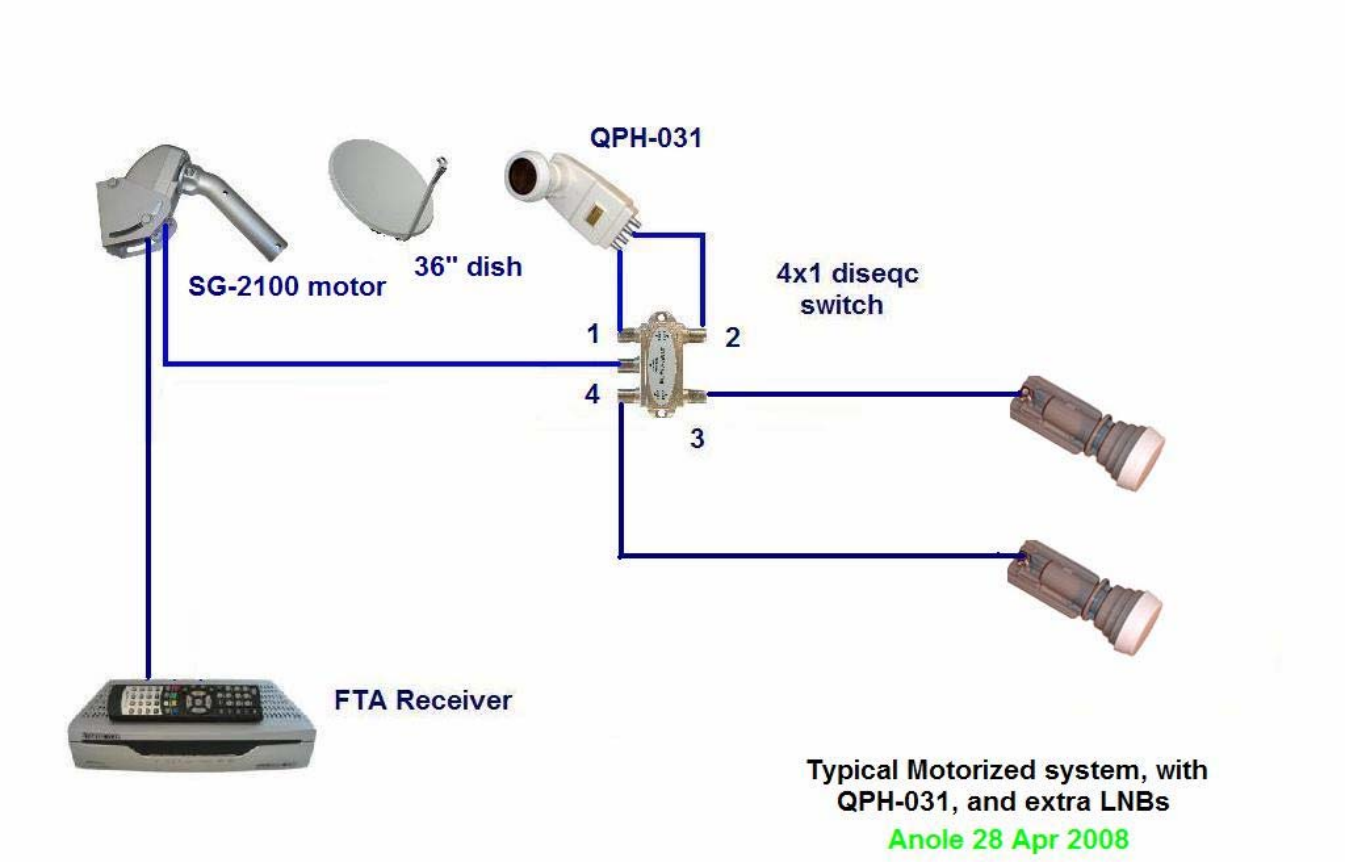




Typical Application: Motor & QPH-031 LNB

Okay, so you bought the package system, with all the upgrades:
- motor
- 36" dish
- Invacom QPH-031 linear & circular LNB
- diseqc switch
- well supported blind-scan receiver

Congratulations on a fine selection.



dwg 3: basic motor-switch-LNB hookup

Since the Invacom QPH does linear -and- circular mode on different connectors, the diseqc switch is used to select the desired operation mode.
(unused LNB connectors could be hooked to another receiver)

There are two free diseqc switch ports which could be used for other LNBs.
In this example, the extra LNBs can be Universal or Standard, as there is nothing to interfere with their operation.
Many users have a dedicated dish for G10R (123ºw), so they can change to that bird without waiting for the motor.

Eight LNBs and one receiver

This is my dream configuration, for use with a single FTA receiver.
On the left, it has C & Ku band LNB, plus two DBS or Standard LNBs.
They could be any combination of Standard LNBs.

On the right, four more LNBs can be either Universal or Standard!.
edit: well all the LNBs to the right get the 22khz tone.
The Standard LNBs will ignore it.
Universal LNBs would switch to the high band.
If you wanted low band, then you are out of luck.

This all works because the Ecoda 22khz switch passes the tone bursts on to the diseqc switches.
A regular 22khz switch would not work at all , wired this way.

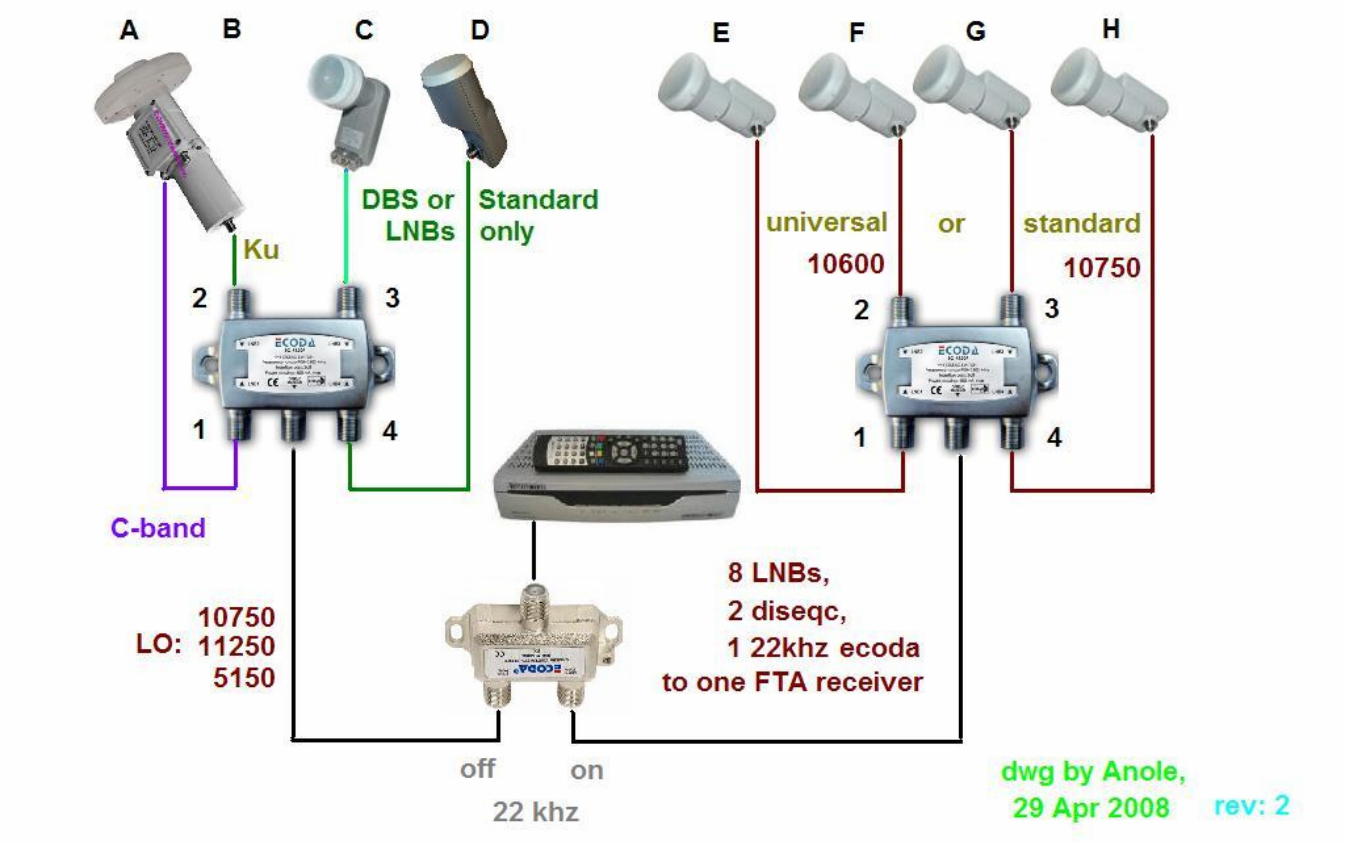
edit: **Switch Setting Information**

Code:

```
 Assume the LNBs are marked from left to right as:
on the left diseqc switch: A=Cband, B=Ku, D=DBS, E=Standard,
on the right diseqc switch: E, F, G, H

LNB   diseqc   22khz
----------------------
 A      1       off
 B      2       off
 C      3       off
 D      4       off
 E      1       on
 F      2       on
 G      3       on
 H      4       on
```

dwg 4: Probably the best bang for the buck, with least connections, and great flexibility for one FTA receiver.



This is the precise setup I use with my Twinhan 1020a with 4 universals acting as standards with LO of 10600. It also works with my Coolsat 5K and Traxis 3500. All three of those receivers are diseqc 1.1 compatible with many more possibilities using switches.

The beauty of this setup is that you can also use it with a Pansat 3500, or a Fortec Mercury II which are only diseqc 1.2 compatible and still get 8 LNBs on one receiver.
On my setup to use the Universals, I have it like this:

Ecoda 22Khz on side then to a separate 4x1 diseqc with the 4 Universals each on a separate port.

In the receiver, I select each port for it's satellite with 22Khz turned on. The Ecoda then sends to the 22Khz on side which passes through the diseqc to each individual LNB using only the 22Khz on high side of the LNB.

I don't know if other 22Khz switches work like that with Universals, but only the Ecoda switch will pass the diseqc commands.

Quote:

> Originally Posted by **Iceberg**
> *I thought you couldn't do a 22k with a Universal?*
> *Does the ecoda work differently for that?*

Quote:

> Originally Posted by **Linuxman**
> *This is the precise setup I use with my Twinhan 1020a with 4 universals acting as standards with LO of 10600.*

Yea, that's the cute trick.
In dwg 4, above, the four LNBs on the right are on the *22khz On* side of the Ecoda.
So, the right diseqc is sent a constant 22khz whenever it's selected.
That means all the right LNBs get 22khz.

So, if they are Standard, they ignore the tone...and their LO is 10750.
However, if they are Universal, they use the tone to switch into high band mode... and their LO is 10600.
Of course, the catch is that the Universals cannot switch to low band... but for 99% of the birds, that's just fine.
I've picked up a lot of cheap Universals over the years, and this is a good way to get some use out of them.

The other side of the coin is that the four LNBs on the left side of the drawing cannot be sent 22khz tone.
So, if you really wanted to receive something with a Universal in the low band, you could put the LNB here.
But then there would be no way to switch it to high band.

I didn't say this drawing was perfect, just that it was my favorite.
It's sort of a cheat, like hooking just one polarity of an LNB to only one side of a multiswitch, to get more LNBs.

Quote:

> Originally Posted by **wstef721** VIEW POST
> *I have a 90cm dish with a dual output Universal LNBF pointed at Galaxy 25.*
> *I would like to connect up to 4 receivers to this dish. Is this possible?*
> *All of the receivers will be emitting the 22khz tone to ask for the high LO.*
> *Will they interfere with each other if I use a standard 3x4 multiswitch?*

You seem to have a good grasp of the problem... and solution.
I believe what you have described should work fine.

I'll be getting to multiswitches over the next few days, as time permits.
Should get to complicated multiswitch/diseqc combinations by the weekend.

Quote:

> Originally Posted by **wescopc** VIEW POST
> *Anole,*
> *I love your drawings, do you do those in Paint? I need to take lessons.*

The secret is making up a library of pictures of around 100x100, up to 200x200 pixels.
At least that's how I started out.... at about 100x100 per icon, and my older drawings use that standard.
For the first two drawings of this series, I didn't have many elements, and to fill the page, I used 200x200.
But as the drawings get more complicated (there are several more to come), I'll revert back to the smaller size icons.

I also have other tools to flip and rotate the images before use.
It actually takes Lview to resize and flip, ACDsee to rotate and preview, plus Paint to make the icons into drawings.
Takes longer to say than to do.... once you have the pieces... but making the pieces is half the job.

I'm actually about to audition another program, which may replace all of the above.
Not sure whether to change gears in the middle of this project or not.
... and this just in.... I may steal some nice finished drawings for part of the multiswitch discussions.
That'll save a lot of work by not duplicating work that's already done.

Quote:

> So as long as the 22k side of the ecoda has that LNB it should work then? The LNB LO on the SC dish is 10750 22k on for that LNB

Yes, it should work fine.

When choosing the LNB type on some receivers, the receiver may not allow you to choose whether the 22Khz is turned on or not, especially if you tell it is a Universal.

Then just choose standard and set the LO where you want it and all is well.

Movin' On To Multiswitches

Recap:
Okay, we've covered two kinds of 22khz switches - the regular and the Ecoda.

We've dealt with one kind of diseqc switch (which come in 2-input and 4-input varieties)
Later in the advanced section, we'll get to the other kind.

Now it's time for basic multiswitches.
Again, there are two kinds, and we'll cover both.

Remember, this thread is organized for the beginner, with the easiest and most likely solutions listed first.
As we get deeper into the subject, the more exotic switch configurations will be dealt with.

Two Kinds of Multiswitches

They have two inputs or they have four inputs
That's it. Those are the two kinds.
(hold your questions on 3- and 5- input switches for later*).

The two-input models *require* both outputs from a dual output LNB.
So, it's really a one-LNB switch...
The receiver selects Vertical or Horizontal by feeding the switch 12 or 18 volts, respectively.

The four-input model *requires* both outputs from -two- dual output LNBs.
So, it's really a two-LNB switch...
As above, you select Vertical or Horizontal with 12 or 18 volts, and ...
... and, you select which LNB by supplying a solid 22khz tone or not.

Commonly available switches have two or four inputs and four or eight outputs.
There are some with more than eight outputs, but the basics described are the same.
We will deal with the simpler designs such as:
2x4 = two inputs (one LNB), and four outputs
4x4 = four inputs (two LNBs), and four outputs
4x8 = four inputs (two LNBs), and eight outputs for those really big jobs!

Recap: So, those are the two basic kinds:
- 2 input with no 22khz switch
- 4 input with a 22khz switch

***** 3- & 5-input switches
These have one extra input to take your outdoor TV antenna and feed it down the same coax on your four (?) switch outputs.
In your living room, you would use a diplexer to split the feed, routing the satellite signal to your FTA box, and the local antenna signal directly to your TV set.
Because many installations will require other antenna-incompatible switches to follow a multiswitch, we will not give odd-input switches serious discussion.
Of course, if they are cheap, we can ignore the extra input.
Diplexers also introduce some loss to your signals, so I'm not a big fan of 'em.

Using Two-Input Multiswitches

In our first example, we have one dual-output LNB and want to hook it to 2-, 3-, or 4- FTA receivers.
The switch has two inputs labeled: 12v and 18v.
Each puts out the marked voltage to one half of the LNB.
So, each half of the LNB puts out Vertical or Horizontal, respectively.
Depending on which voltage the FTA receiver supplies on its input cable, the switch gives the receiver the corresponding polarity.
And regardless of what other receivers want, both polarities are always available to all receivers.

Special Case: old Primestar LNB
Some, old Primestar (or similar) LNBs had two outputs, but one was fixed with the Vertical polarity and one was fixed with the Horizontal polarity.

Didn't matter what you did with the voltage, as they had no internal switches.
Using a 2x4 multiswitch to connect to both LNB terminals would work to supply all receivers with either polarity, just as in the first case.
Make sure you hook the LNB V terminal to the switch 12v input, and the H terminal to the 18v input.

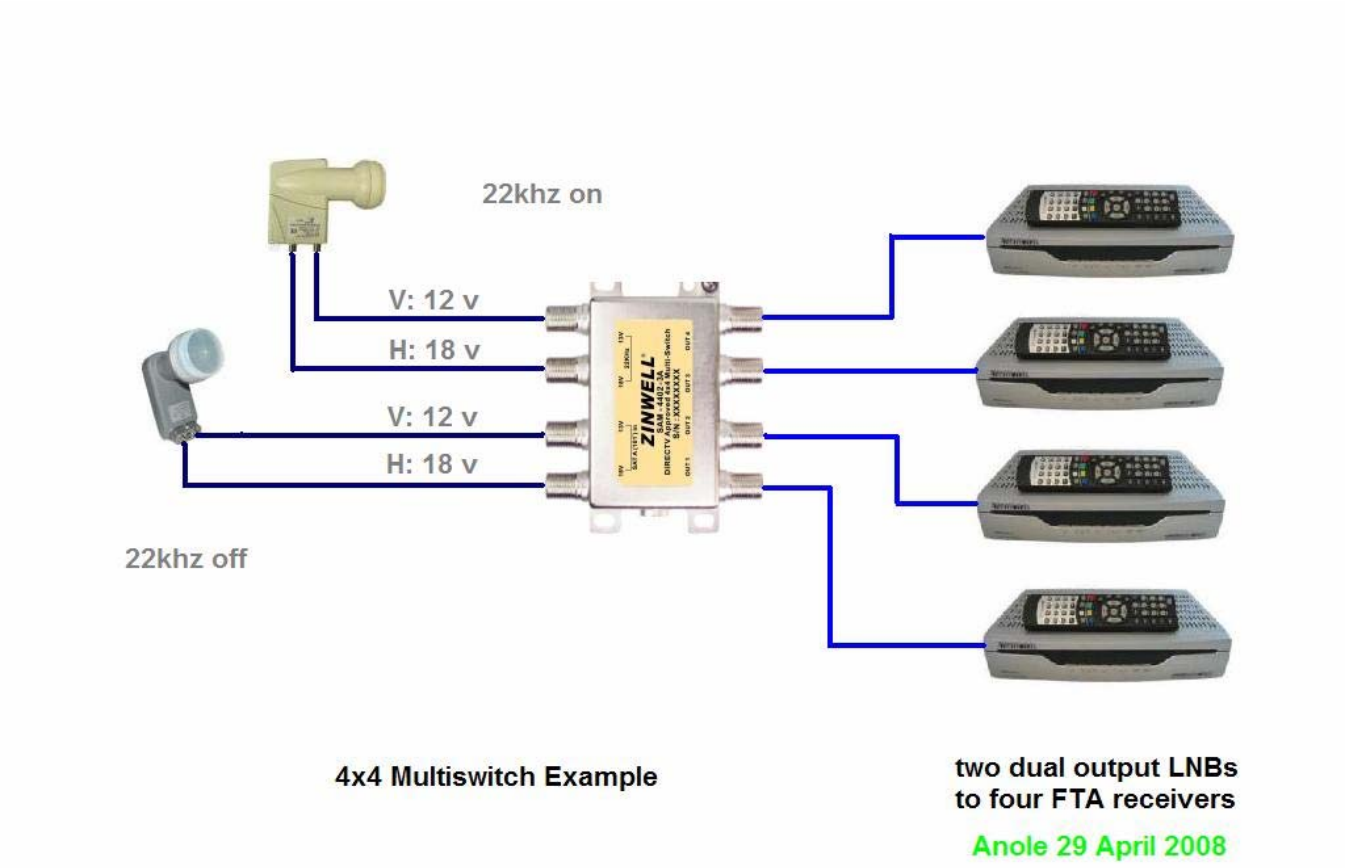
Using Four-Input Multiswitches

The four-input switch allows you to connect two LNBs to many receivers.
The voltage switching works exactly as described above for two-input switches.
The extra trick to select between the two LNBs, is to use 22khz on or off.

dwg 5: two LNBs with a 4x4 multiswitch and four FTA receivers
I didn't think it was really necessary to post a picture with one LNB and a 2x4 switch.

These examples may seem too simple for many, but understanding how switches work lets you use them as building blocks for more complex switch installations.

. . . as we will see in future installments . . .



4x4 Multiswitch Example

two dual output LNBs to four FTA receivers

Anole 29 April 2008

Real-World Multiswitch Example - 3 LNBs, 3 Receivers

Here is a design that was requested by a user who had specific requirements.
It may or may not suit your needs, but it's a good example of what we learned above.

Three receivers needed to be supported, and fed by any of three dishes.
The dishes had -
- a Universal LNB

- a DBS LNB for NASA/AngleOne
- C-band, and we used an uncommon dual-output LNBf with voltage control

Or maybe all the LNBs were on the man's C-band dish, just with various offsets.
Perhaps he moved it with his analog receiver.
It really doesn't matter for the switch discussion.

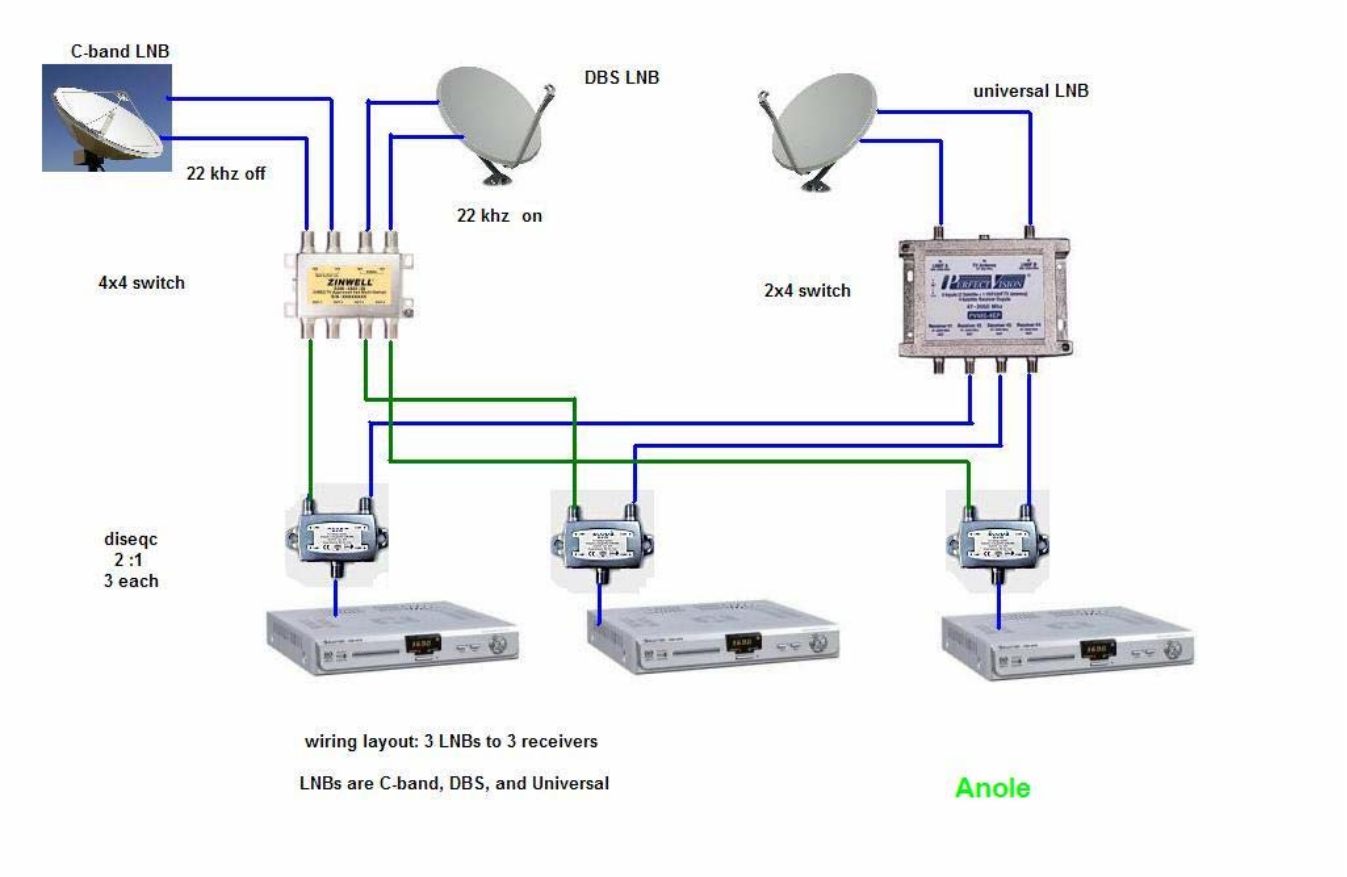
The 4x4 switch on the left uses 22khz tone to pick the C-band or DBS LNB.
It has four outputs to be routed to receivers or additional switches.

The 2x4 switch at the right feeds the Universal LNB to four outputs, and passes the 22khz tone to the LNB to let it select high band or low band.

The 2-input diseqc switches at the bottom let the receiver choose which multiswitch to listen to.

Obviously, you could have four receivers by adding one more diseqc and the 4th FTA box.
To expand this idea to support up to eight receivers, the multiswitches would need to be 4x8 and 2x8, respectively.

Likewise, you could add more LNBs and multiswitches if you had diseqc switches with four inputs (pretty common ones).



dwg 6: three LNBs, and three receivers

Switch Information:
Code:

```
..
 C-band  : diseqc 1, 22khz off, 12v=Vertical 18v=Horizontal
 - DBS - : diseqc 1, 22khz on , 12v=Vertical 18v=Horizontal
Universal: diseqc 2, high band, 22khz on , 12v=Vertical 18v=Horizontal
Universal: diseqc 2, low band , 22khz off, 12v=Vertical 18v=Horizontal
```

Up tomorrow? 8 lnb & 4 rcvr. Switch table & dwg are done. Busy day, so probably in the evening.

Real-World Multiswitch Example - 8 LNBs, 4 Receivers

For those readers who have been following along, this layout should pose no problem.

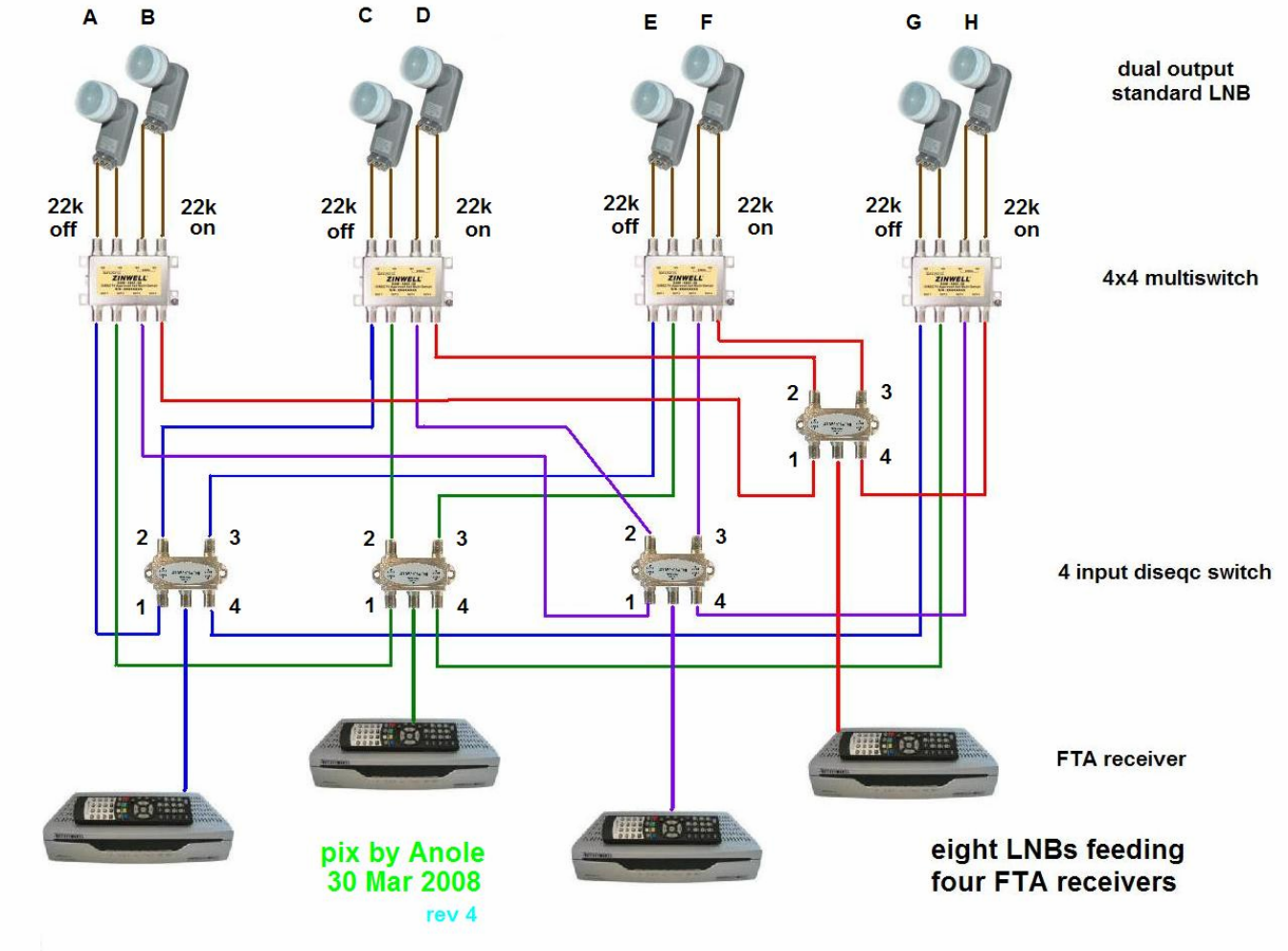
The LNBs need to have dual outputs, and be Standard.
The multiswitches are 4x4's. The diseqc switches are 4x1's.
Eight LNBs will satisfy all but the most die-hard T-90 users.
And if you need more than the four FTA receivers shown, this design is *easily* expanded to eight receivers with no problem at all.

Each receiver has its own diseqc switch to talk to.
The switch picks an output from one of four multiswitches.
Then, 22khz *on* or *off* picks the right or left LNB of each pair.

Switch Information:
Code:

```
LNB   diseqc   22khz
--------------------
 A      1      off
 B      1       on
 C      2      off
 D      2       on
 E      3      off
 F      3       on
 G      4      off
 H      4       on
```

dwg 7: - 8 LNBs and 4 receivers



Great thread Anole. This may be off Topic but since I now have 2 - C and 2 - KU working LNB's is it possible to show the hookup / drawing that Linuxman recently spoke about, that is the Chaparral Bullesye II Dual C/KU Feedhorn orthomode transducer? Do you need to purchase additional switches to power the 4 LNB's for V and H polarity? If so do these Switches need to be installed at the Dish, or can they be cabled back to the Dish from inside the House? And will they work with just a FTA type of receiver?

Current Setup:
12 Ft Mesh Bud Dish, Chaparral Co-Rotor II with Norsat 4506A KU-Band & 8515 C Band LNB's. V-Box III. 100 cm Fortec Star Dish, Stab HH120 Motor, Invacom QPH-031 LNB, ViewSat Extreme Receiver. Bell ExpressVu Dual LNB Dish 500, and Bell ExpressVu Dual Tuner 9200 PVR Receiver on Subscription
Thanks.
I believe you can just use the left half of drawing #6, above.
Hook your two C-band LNBs to the two C-band wires shown on the switch.
Then, connect the two Ku-LNB outputs to the switch where the DBS LNB is shown.

If that's all you need, then connect the four outputs of the 4x4 switch to your four receivers.
If you want to bring in more LNBs, then take a look at drawing #7 for inspiration.
In that case, connect the two C-band LNBs where the two outputs of LNB A go...
... and the two Ku LNB outputs to where LNB B goes to the switches.

Okay this thread was about simplifying the basic switches.
I hope we've covered all the basics, so the reader can come up with his own designs.
That means the job is done. -

Getting Complicated

Going beyond eight LNBs or four receives, is getting into the more complicated realm.
I know some users would like to support twelve, sixteen, twenty, or maybe thirty-two LNBs , perhaps for their T-90 dishes.
Ya just can't get there with *only* the basic building blocks shown above.

There are DISEqC switches with eight inputs and one output.
They operate in diseqc 1.1 mode and that's not supported by all receivers.
Unfortunately, there is not enough info published by users here, for me to fully explain their operation.

A couple of members have posted reviews and usage descriptions of these 8x1 switches.
If anyone wants to take over and make a description of the full capability of any of these switches, I'll supply the wiring picture.
And I'm not sure the two 8x1's I've heard about, are equally interchangeable.
Need a list of capable and incapable receivers to go with any such further discussion, too.

As a hint of possible things to come, here are some 1-receiver ideas:
- FTA --- eCoda --- 2 each 8x1 diseqc = 16 LNBs (some restrictions on Universals)
- FTA --- 8x1 diseqc --- 4 each 4x1 diseqc = 20 LNBs (no restrictions on Universals)
- FTA --- 8x1 diseqc --- 8 each 4x1 diseqc = 32 LNBs (no restrictions on Universals)

Multi-receiver ideas I could envision right off the top, include:
- 8 each FTA receivers - 8 each 8x1 diseqc --- 8 each 4x8 multiswitch = 16 LNBs (Standard LNBs only)

But, since I don't know enough about the 8x1's, and don't have any to play with, the above ideas are just speculation.

My EMP Centauri 8X1 works well following a standard 4X1 Diseqc switch - so:
FTA ---- 4X1 ---- (4 EMP Centauri) 8X1 = 32 LNB's (universals OK)
FTA ---- Ecoda 22 khz --- (2) 4X1 --- (8 EMP Centauri) 8X1 = 64 LNB's (NO universals)
Bob

Oh, I was under the impression the 4x1 disecq's had to be between the 8x1 and the LNBs.
Didn't realize the 4x1's could be located between the FTA box and the 8x1's.
Well, that opens up a whole new list of available configurations.
Thanks . -

I contacted Iceberg today, and he's working up some more good descriptions and drawings.
That's what it'll take to get coverage on the 8x1's as I'm well out of my element with them.

If anyone needs 8x1 support drawings, I can help out.

And if anyone needs custom drawings for the less complicated stuff discussed in the first two pages of this thread, I'll try to help, too.
Or switch tables, too.