10m Expedition Kit User Guide Version 1.1 June 2019

Congratulations on the purchase of your DX Commander Expedition Antenna KIT

SAFETY NOTE

DX Commander antenna components are designed for hobby radio amateurs by Callum McCormick, M0MCX. Radio Amateurs pass exams where health and safety is included in the syllabus. Please be careful in your handling, erection and general usage of any DX Commander parts so that yourself, property or a third party in the vicinity of your antenna experiments remain safe. Note also that engineered parts can have some sharp edges so be careful before handling roughly with bare hands.

Overview: The antenna runs up to 4 elements, delivering (mostly) quarter-waves with a single feedpoint and is a similar concept to a fan-dipole, but turning the "fan" 90 degrees on it's X-axis and placing one side of the fan vertically. It is also possible to run the 4th element up the middle of the antenna.

With just 3 elements, a user can dial in 40m, 20m, 17m. 40m will give you 15m band on a pseudo 5/8th antenna. Removing the 17m band, you can turn this into a contest/field-day antenna running 4 elements; 80m (inverted L), 40m (which also delivers 15m), 20m and 10m.

Many permutations possible or combinations thereof including a dedicated WARC antenna for 30m, 17m and 12m. It is my opinion that for SOTA and general /P use, the favourite method will be to run 3-elements for 40m (and 15m), 20m, 17m, depending on the sunspot cycle.

5/8th for 10m band: If the sunspot cycle is working in your favour you can tune in 10m band as a 5/8th. Just Fold-back a longer 30m element for a 5/8th on 10m (just like we do for 40m and 15m).

You can either be very fussy and carefully tune each element for a "No ATU" system or get it "near enough" and use your inbuilt tuner on the radio. You will not need an outboard ATU, whichever way you go. In testing and during my experiments (and during the IOTA contest), most users (including me) achieve better than 1.5:1 SWR across all the used bands.

Of interest, this antenna should give you a perfect tune on the 6m band (depends on exactly where you tune combination of 40m (and/or 30m band – I've never bottomed this out) however it should be noted that the far-field pattern will not be optimised for DX for this band. One of my videos demonstrate 6m band using 30m element and FT8 signals very VERY loud, so who knows..!)

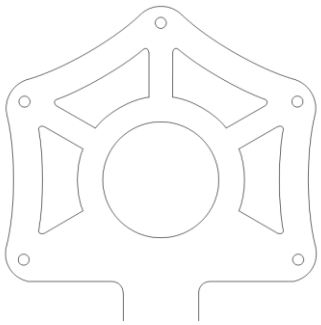
Parts list

1. DX Commander Expedition 10m Pole
2. Ground Plate 3mm aluminium
3. Radiating Plate 3mm aluminium
4. 6-hole Guy Plate - UHMWPE
5. Upper Spreader Plate - 5mm UHMWPE
6. SO239 Assembly with flying lead
7. Appropriate number stainless bolts
8. Appropriate number stainless wing Nuts
9. Plenty of Fork Connectors (earth)
10. Plenty of Fork Connectors (elements)
11. 2 x Stainless Hose clamp
12. Some tubing
13. 4mm elastic shock cord
14. Paracord for guys & element extensions
15. 12 Plastic Carabiners that snap together
16. 15cms (4 inches) of glue lined shrinkwrap
17. 100m DX10 wire New Mil-Spec wire

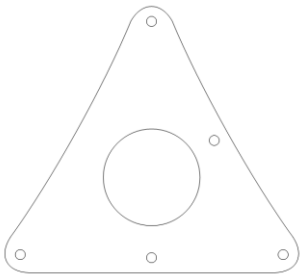
Please make yourself familiar with all the parts and satisfy yourself that all is present and correct. I take great care when I pack these boxes so if something is missing, it's my fault. I do make mistakes!

In Detail

I have a user guide for the pole(s) themselves and you can find the user guide on the website under User Guides. The pole extends to around 9.5m and is substantial enough for this use. Be careful if a storm is forecast.

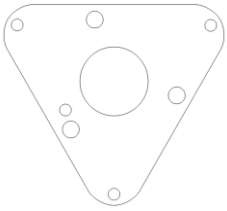


Ground Plate: This is made from 3mm aluminium with a single bend for the SO239 assembly and 5-holes for ground radials. I personally tap these 6mm threads. It is possible to fit 6 radials per fork connector, achieving way more radials than most people need. If required, you can double up on fork connectors to make a ridiculous amount.

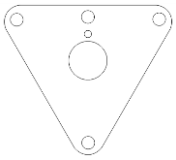


The Radiating Plate is machine cut from 3mm aluminium. The “flat” side is for your SO239 and the spare hole on one of the curved sides can support a 4th element.

The Guy Plate allows for three guy points (larger holes) and up to 4-elements. The guy point fits on top of the 2nd tube. It is made from UHMWPE and is extremely substantial. Holes are the right size to fit either 3 or 4 elements) and the guy point will allow 6mm alloy carabiners (not supplied) to be connected with room to spare. Alternatively, just tie your guys to this point to simple guying stakes. I like carabiners because I can easily disconnect and lay antenna down and erect speedily.



Upper Spreader: Fits at around 4.9m point. Has three corner holes and a centre hole for a 4th wire element (unless you chose to place your 4th element right up the inside of the tube). Supplied plastic carabiners fit these larger holes. The very small hole will allow you to pass a small wire element right up the side of the pole.



The SO239 assembly comes with a flying lead. These are soldered to the SO239 before hot glue is applied. This assembly is then reheated with a heat gun to ensure a weather proof seal. A fork-connector is fitted.

The supplied hose clamps need to have the tubing fitted. Cut the tubing and unscrew the hose clamps and fit the tubing. You may use hot water to assist, depending on hose and clamp size.

The black plastic carabiner clips are for making up the extensions for paracord (and shock-cord), connecting your elements to the Upper Spreaders. The holes on both Upper Spreaders are correctly sized to fit the carabiners. Use about 15cms (6 inches) of shock cord per element and make the rest of the extension to your element with paracord. Connect the shock-cord to the paracord with a "fishermans knot". Seems to be the best. You can trim and seal the knot afterwards with a flame.

TIP: If you are using one of the corner holes for a longer element (say 30m or 40m) make a small loop about 100mm (4 inches) down from this Upper-Spreader directly on your long element. Use glue-lined heat-shrink to keep this loop stable - and small enough so that it will still fit through the nylon Guy Plate hole. Add a small section shock-cord and the carabiners to connect the longer element loop to this Upper Spreader. Continue the element up to the pole and secure either with electrical tape – or use some small tubing (depending on length). It’ll just keep your element below the 5m point secure and balanced to the other elements.

Finally, don’t over-tension everything. Your shock-cord should have a little ”give” left else you may over-stress the fork connectors.

ELEMENT PLACEMENT

It doesn’t seem to matter which hole has which element. Just make up your elements according to the chart below. Trim to suit.

TIP: Use a Sharpie or perhaps a label printer to mark all the positions on the Driven Plate, Spreaders and elements because in the heat of battle, it’s possible to end up pulling the wrong element up through the Guy Plate and even connecting to the wrong place on the Upper Spreader. It'll still work - but it'll look wrong. Perhaps colour coding might be cool so that 40m holes and elements are red, all 20m are yellow etc..!

ELEMENT LENGTHS

Pure copper un-insulated wire has a different velocity factor to insulated wire so if you cut your element lengths according to the maths, you’ll find they are too long.

For instance, the wavelength for 14.225 MHz is 21.09m long (not 20m). A mathematical quarter wave of this will be 5.27m. It turns out that the wire I use has a velocity factor of around 93-94% which is why we can cut the wire shorter.

Anyway, using the maths, we can extrapolate all the other bands and my IOTA version ended up being:

- 10m – 2.45m + 5 cms foldback (for the heat shrink loop)
- (Optional) 10m (as 5/8th) 6.7 plus 1.10m foldback
- 12m – 2.78m + 6 cms foldback
- 17m – 3.83m + 6 cms foldback
- 20m – 4.82m + 20 cm (longer foldback compensates for slightly shortened element)
- 30m – 6.74m + 6 cm foldback
- 40m – 11.15m (foldback back down pole which will also give you physical 5/8th for 15m)
- (Optional) 80m - 19.5m of wire (go up to where your 30m would have been (about 6.7m high) and then throw the remaining element over the nearest tree or through a window, using paracord and a small weight. I discuss this on one of my videos.

Fit any combination you like. Note that 80m can conflict with 17m band due to harmonics.

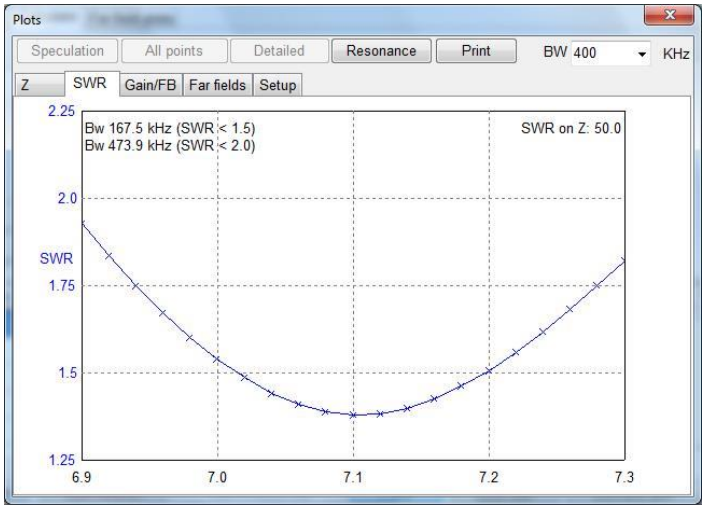
ONLY Fit your heat-shrink and final carabiners to paracord / shock-cord ***after*** you have sorted all the element lengths out. This way, once your ABV works to your liking, you can heat shrink the elements and do a final fit of your carabiners to the paracord.

40m and 15m CONUNDRUM

For purists, this is quite a bit to get your mind around, so bear with me.

A quarter wave for 40m band has a very wide bandwidth. It's huge. It means we can trim our 40m element pretty much anywhere we want and we'll always be able to get a great tune.

Here's the s/w plot with an element cut for a frequency of 7.1 MHz. You'll notice, we're still under 2:1 SWR from 6.9 MHz through to 7.3 MHz. In fact, under 3:1 SWR, the bandwidth is almost a whole MHz wide. In the field, it appears even better.



USING 40m ELEMENT ON 15m BAND

According to the books, dipoles and verticals resonate on every odd harmonic. This means that according to the maths, our element tuned for 7.1 MHz should also be resonant on 21.3 MHz. If it were that simple, I wouldn't be writing this.

In practice however, the third harmonic is much higher and I really don't know why. Even the software modelling puts the resonant third harmonic frequency for a tuned 7.1 MHz vertical at 21.6 MHz. Too high.

The easy way out of this dilemma would be just to create a longer element for the 40m band. A longer element by adding another 10cms would still tune the whole of 40m band just fine and achieve a perfect tune at 21.25 MHz. And this is what I used to do. It would annoy me that the wire though was slightly longer than the pole itself and the very top of the element would waggle about in the air. Sure it worked, it just didn't look right.

Now, completely by accident, I happened to create a new set of elements as part of writing an updated user-guide to achieve very accurate element lengths and to determine what impact (if any) the amount of fold-back had on the tune.

I cut a random element length, slightly too long for 40m (actually 11.06m) and folded the spare amount of wire for this long element back down the top section of the DX Commander pole, as far back at the bottom of the second to last section. (bottom of tube #2). I considered this would be too long at the time.

It turns out that I did achieve a perfect tune for 40m, but this “top loading” meant I also found a perfect match for 15m band. Actually, the tune ended up at under 21.1 MHz. You can cut the fold-over shorter and move the 15m up should you wish. It now starts behaving similar to a 5/8th wave.

Both 40m and 15m are benefiting from this long fold-over but to different effect. 40m is probably hardly seeing this fold-back since I can cut this back quite a lot and almost nothing happens to the tune.

On 15m, this foldback seems to be a superb accident. And although the 2:1 bandwidth is still over 400 KHz, it allows the keen operator the ability to tune the element to the portion of the band you want your lowest SWR (CW, Digital or SSB). Pruning this foldover has negligible effect on the 40m band tuning. One DX Commander user called this foldover method a “boomerang” match which seemed to have stuck!

The added benefit is that the physical length of this 15m element becomes close to 5/8th wave. I believe this is why I achieved such a great result on 15m band during the IOTA contest.

ADDING 80m

I successfully changed out the 30m element for a 19.5m long element as an Inverted L on the All-Band-Vertical Classic in 2017. I’ve not tried on this Expedition pole. But I see no reason why it wouldn’t work. On my own Classic antenna, it tuned very well from 3.65 through 3.8, under 1.5:1 SWR for the IOTA contest. The vertical component was originally around 6.7m high – however on the Expedition pole, I suggest you start your “inversion” at the 5m Upper-Spreader point. You may need slightly longer piece of antenna wire. Suggest you start with 20.5m. Note, you will get a lot of bend on the pole in this configuration. Although it might not look pretty, it’ll still work :)

GLUE LINED SHRINK WRAP

Find some lengths of this in your kit. You only need a small amount per element to make loops at the top of each element so that the carabiner can to clip to it. Only fit once elements are correct (start with electrical tape) because once fitted, they are a nightmare to get off. Further, remember to only fit the lower carabiner to your shock-cord once your element lengths are confirmed. Until then, make your paracord a little longer and just tie a loop (carabiners are difficult to remove too!). Alternatives to a genuine hot-air gun are: plumbers blow torch, low gas flame on kitchen hob, steam from a kettle or a lighter (watch for carbon deposits).

HOSE CLAMPS

You will certainly need 2 x hose clamps. One to keep your radiating plate from creeping up the pole – and the other one between the driven plate and the guy plate. I have found this pole very “sticky” so for true /P operations, I wouldn’t bother trying to make up a ton of hose-clamps. Perhaps use electrical tape if concerned?

RADIALS

The wire in your starter kit will give you around 70m of spare wire after you have built your elements. Use this to build 20 x 3.5m radials in 5 bunches of 4 radials. Effectively, this is almost 2-wavelengths of radials at 40m band and 4-wavelengths for 20m band. Plenty. If you need to add 80m, find some very light-weight “equipment wire” for the element and get some more radials down.

To give you more confidence, you may also enjoy my video here: https://youtu.be/m-8P1-PfT9s

FOLDING BACK INSULATED WIRE

The last thing I wanted to mention is the topic of how much folding back elements on themselves has an affect on the tune of an element.

I have made some preliminary tests and although we are schooled by our teachers to fold back wire on itself to decrease the length of an element (say a dipole), I have discovered that the new length becomes a combination of the actual element length plus a proportion of the fold-back, not all of it.

Upon further investigation, it transpires that nobody has really done the field work (apart from me!) to settle this argument. The portion of the element that is folded back, will have an impact on your tune - but not in a linear fashion. Actually, my field work is suggesting that every 2.5m of (insulated) wire added back on itself counts as 1m of real length. I need to make a video about this and show you the maths, Trust me! :)

FIRST-TIME ASSEMBLY

Prepare all your elements as the cut chart and solder / crimp the fork connector.

Reserve circa 12m of wire for mistakes / changes. You can add this amount back to your radials when your build is complete.

Make up your radials. 6 radials will fit into one fork connector if required. A proper set of wire-strippers helps here.

Prepare your hose-clamps and clear plastic tubing as discussed earlier.

Hammer three guy stakes into the ground, 120 degrees apart from where the centre of the mast will end up, 120cms from the centre (4 feet).

Extend the pole in your working area and twist-lock each section very firmly by pulling, twisting and extending at the same time - and then test-erect by eye. Although easier with two people, it is possible to fit fully yourself by resting the upright pole on your shoulder after previously looping the guy cord around each of the guy stakes and tying off. Adjust to suit. When taught, release one guy point and lay on ground (I prefer a couple of garden chairs to ease my back at this point).

Unscrew the bottom of the pole and fit the ground Plate to the thread and re-tighten the base.

Slide the circular Radiating Plate over the pole so that it fits snugly at the bottom of the mast, on top of the plastic moulding. Use a hose clamps to stop it from slipping around. Do not over-tighten.

Slip over another XL hose-clamp and tighten just at the join between section 1 and section 2 (there will be downward force here from the guy point. Now slip over the Guy Point.

Test fit the Upper Spreader (which can act as an optional Upper guy-point for severe weather).

Using the 6mm bolts, washers and wing nuts, fit the elements to the Radiating Plate and thread each vertical through an appropriate hole in the Spreader Plates.

Once you can judge the element lengths, prepare some shock cord of appropriate length and fit a carabiner to one end - then clip to the Upper Spreader. Temporarily connect an appropriate length of paracord to the elastic. Make a small loop at the right place at the bottom of the paracord for the element to loop through. You are currently making everything temporary at this point to check element lengths. Bear with me..

For the 40m element, continue right to the top and poke the remainder down the hole in the top of the pole. Longer the better so you can trim to suit.

Reserve a tiny section of the tubing we used for the hose-clamps, and slip this over the top. You can now tension (slightly) the 40m element to make it look just right.

I'm assuming you now have all the elements connected to the Radiating Plate which now have temporary loops held in place with electrical tape, connected to the paracord which has a temporary loop in place. The paracord is connected to the shock-cord, again with a temporary knot - but with the carabiners permanently secured to the end of the shock-cord, clipped to the plastic Spreaders.

Connect the SO239 flying lead from the Ground Plate to the Radiating Plate.

Raise the whole pole vertically and check you have moderate to low tension on the wires to keep them from blowing about too much, you can guy off the vertical and connect the rest of the radials.

Check SWR. You can now make as many adjustments as you like before finally making the knot between the paracord and the shock-cord permanent and finally connecting the paracord to a carabiner.

This nifty SWR adjustment calculator may assist:

https://www.m0mcx.co.uk/quick-swr-calculator-for-vertical-and-dipole-ham-radio-antennas/

Last job will be replacing the electrical tape with permanent glue-lined heat-shrink.

WARNING: Do not rush the build. A tiny mistake can take a load more time to correct. Take your time, enjoy the build. Yes, there are some people who have built this inside half a day. But others have taken a more laid-back approach over a weekend and ended up with a superior build. I am always very fussy when I build mine. I like to know it all works, connectors are soldered nicely and everything is just "so". You will have a real sense of achievement when it comes together, particularly when you start hearing DX stations you have never heard before. It's an amazing design.

I realise this is not an expensive kit. It is what it is, a relatively cheap fibreglass pole and a few connectors - and as about economical as I can make it. But the end result is really quite remarkable.

Finally, PLEASE check out my YouTube channel. Although I make films on many aspects of the hobby, there are some gems when it comes to this particular design.

https://www.youtube.com/user/m0mcx

NOTE: If you are using near salt-water with strong breeze, you may observe ANYTHING can start corroding. Salt water is VERY corrosive and this kit is not “marine hardened”. To help in this regard, connectors and other metal parts may be squirted, brushed or have applied a variety of goop: WD40, Vaseline, silicon grease, WaxOil etc. This will stop oxygen getting in.

Your Notes