10m Expedition Kit User Guide Version 1.3 May 2020

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. There is a spare element slot up one side for a 10m (or 11m / CB) element too.

100m of DX10 antenna wire is also supplied. This is an arctic grade PVC wire, tested to 1,600W key down for 65 seconds. Since there are no metal components in this antenna, I would be comfortable rating this for double that for SSB.

With just 4 elements therefore, a user can dial in 40m (& 15m), 20m, 17m and 10m. Like the Classic, 40m will give you 15m band as 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. 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. Even without the 10m element, your ATU will deliver that band. For QRO folks, a dedicated 10m element will be necessary.

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. This antenna is designed NOT to use an ATU though. In testing and during my experiments (and during the IOTA contest - which I won!), 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. You may need to make the 40m ever-so-slightly longer for perfection. This now becomes a 1.75 wavelength antenna which does achieve remarkable low-angle gain, as good as a quarter wave for low to horizon DX.

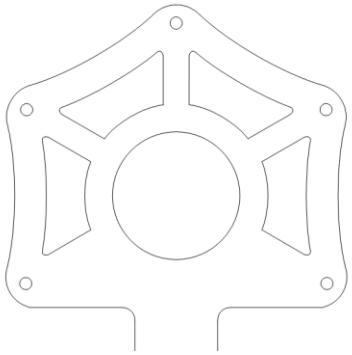
Parts list

1. DX Commander Expedition 10m Pole
2. Ground Plate 3mm aluminium
3. Radiating Plate 3mm aluminium
4. Guy Plate – UHMWPE
5. Mid Spreader UHMWPE (New for 2020)
6. Upper Spreader Plate - UHMWPE
7. SO239 Assembly with flying lead
8. Appropriate number stainless bolts
9. Appropriate number stainless wing Nuts
10. Plenty of Fork Connectors (ground)
11. Plenty of Fork Connectors (elements)
12. Stainless Hose clamps
13. Some clear tubing
14. 4mm “marine” elastic shock cord
15. Paracord for guys
16. 16 Plastic Carabiners that snap together
17. Plenty of glue lined shrink-wrap
18. 100m DX10 arctic grade Mil-Spec wire

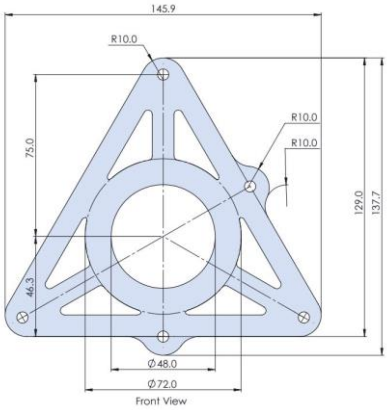
Please make yourself familiar with all the parts and satisfy yourself that all is present and correct. I take great care when I pack these boxes so if something is missing, it's my fault. I do make mistakes!

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.

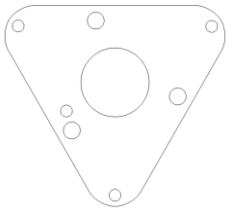


Ground Plate: This is made from 3mm aluminium with a single bend for the SO239 assembly and 5-holes for ground radials. I personally tap these 6mm threads. It is possible to fit 6 radials per fork connector, achieving way more radials than most people need. If required, you can double up on fork connectors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

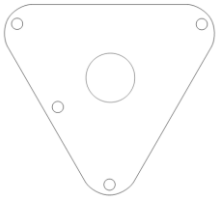


The Radiating Plate is machine cut from 3mm aluminium. Fit SO239 lead to one of the protruded holes, this will leave the "spare" element for 10m.

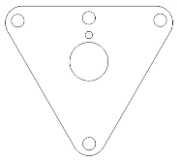
There are three UHMWPE nylon plates in the kit:



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.



The Mid Spreader is also cut in the same material as the guy plate and looks almost identical other than it has a smaller centre hole and no guy holes. The 4th element hole is cut 3mm (1/8th inch) from edge to allow you to cut and fit clip the 10m element to it. This keeps your element from blowing around too much.



Upper Spreader: Fits at around 4.9m point. Has three corner holes and a centre hole for a 4th experimental element. 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 (say 40m). Connects all but the 10m (or 12m) element.

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 reasonable weather-proof seal and glue-lined heat shrink is applied. A fork-connector is also fitted. Use self-amalgamating tape around the hot glue for long term weather-proofing.

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 shock-cord extensions to the various spreaders. The holes on both Upper Spreaders are correctly sized to fit the carabiners.

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 carabiners to connect this 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, although you need a fair amount of tension to keep the elements stable, even in a strong breeze, 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 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. Perhaps colour coding might be cool so that 40m holes and elements are red, all 20m are yellow etc. Find that label printer!

ELEMENT LENGTHS

Pure copper un-insulated wire has a different “length” requirement to insulated wire so if you cut your element lengths according to the maths, you will 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 we use requires factoring a 93-94% change 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:

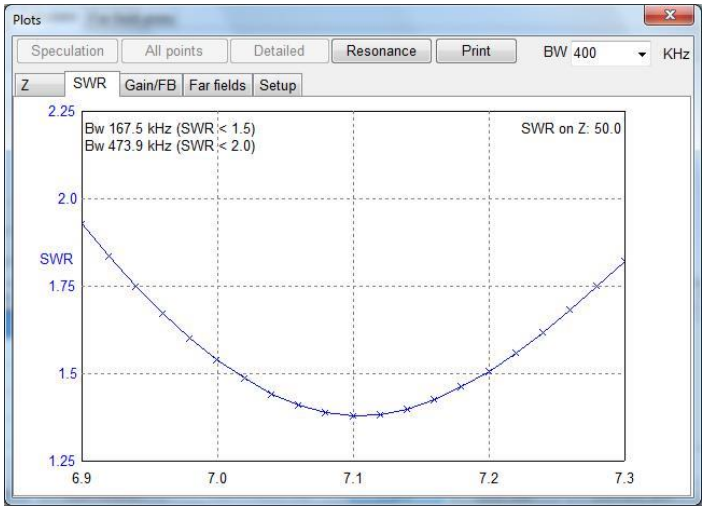
- 10m – 2.5m + 5 cms foldback (for the heat shrink loop)
- 12m – 2.82m + 6 cms foldback
- 17m – 3.84m + 6 cms foldback
- 20m – 4.82m + 20 cm (longer foldback compensates for slightly shortened element)
- 30m – 6.74m + 6 cm foldback
- 40m – 11.20m (foldback back down pole which will also give you physical 5/8th for 15m)
- (Optional) 80m - 19m of wire (go up to upper spreader and then throw the remaining element over the nearest tree using paracord and a small weight. Let it “droop” a bit – don’t over-tension.

30m band: The pole is not suitable for running another UHMWPE spreader high up, like the Classic. Instead for 30m, you will have to use the larger diameter tubing (supplied) to secure some shock-cord to with a stopper knot and connect the element to that. Actually, this was the original design for the classic..!

80m: If you fit an inverted L, cut 19m of wire, go up to the upper spreader and head off to the nearest tree. Light tension only here. Let it “droop”. Note that 80m will give you 30m and 17m with your rigs ATU function.

ONLY Fit your heat-shrink and final carabiners to the shock-cord ***after*** you have sorted all the element lengths out. This way, once your antenna 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 resonates higher due to capacitance changes (and other strange phenomena!) with the longer wire. 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 – and I was always getting slightly higher than designed SWR at the top of 40m.

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. 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. It also turns out that you can cut this fold-over shorter and move the 15m up and down as 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. Start with 19.5m of wire here. Note, you will get a lot of bend on the pole in this configuration. 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 keeps your radiating plate from creeping up the pole, one between the driven plate and the guy plate and also one just under 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. If your system is destined to be installed for more than a day, I found self-amalgamating tape to be perfect in securing the joints, although a pain to remove!

REPEATABILLITY

In practice, I have discovered that you will need to extend the tube out the same amount as you did when you built the antenna in the first place. This makes sure that the distance between the bottom of the element and the upper-spreader remains constant. Otherwise, you may find that the shock cord can either be over-stretched – or not enough. A firm twist and pull will be required to friction fit.

RADIALS

The wire in your starter kit will give you around 80m of spare wire after you have built your elements. Use this to build at least 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. For 80m, I used very light-weight "equipment wire" for the element.

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 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. 4 or 5 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. I rest the upright pole on my 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!).

Unscrew the bottom of the pole and fit the ground Plate to the thread and re-tighten the base. To get a precise fit, “unscrew” the cap anti-clockwise until you hear the click of the threads then it will be safe to start screwing clockwise.

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). Do the same for the next section with the slightly smaller hose-clamp before slipping 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. For very short elements, you may wish to extend the shock cord with paracord. You are currently making everything temporary at this point to check element lengths. Bear with me..

Securing the 40m element: Slightly helically wind the 40m element from the upper spreader to the top of the pole. This will stop it flapping around. Slip over the end of the tube 3 sections of tubing, the larger diameter tubing, a small section of the hose-clamp tubing and also the 6mm (small) tubing. Bring your element up the pole and push it through all three of the these. Make a small loop in the top and come back down the inside (again) of all three tubes. For the 6mm top section, I found it best to remove the tubing from the pole and then arc / curve the last section to slip it over the top. If you get this right, the element will come

up – and back down the inside of all this tubing and you can then slide the tubing back down the pole for a tight fit.

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 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 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 completely “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 and water getting in.

Your Notes