10mABV User Guide Version 1.3 November 2017

Congratulations on the purchase of your DX Commander 10mABV – READ ALL THIS MANUAL ☺

SAFETY NOTE

DX Commander antenna components are designed for hobby radio amateurs by DX Commander Limited. 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 may have some sharp edges so be careful before handling roughly with bare hands.

IMPORTANT: Putting your pole away. In the event, one or more of the top sections breaks free and falls into the base, do not attempt to force a section down on top of it. It is likely that you will not get a perfect telescopic fit. I speak from bitter experience since it is possible to "shred" a section that has lost its "mate". In this scenario, it is best to unscrew the bottom base, pull all the sections out and carefully re-assemble them again.

In the event, your pole is put away in the rain, dry it off before entering long-term storage.

PLEASE READ ALL OF THIS MANUAL ☺

Overview: The antenna runs multiple vertical quarter-waves on a single pole 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.

With just 3 elements, a user can dial in 40m, 20m, 17m and 15m. 4 elements ads in either 30m or 80m (as an inverted L) alternatively, use up all the slots and built a 6-element antenna to cover 80m through 6m (30m and 6m may require inbuilt ATU if using 80m element to dial out a very small mismatch).

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 should not require an outboard ATU. In testing and during my experiments (and during the IOTA contest), I achieved better than 1.5:1 SWR across all bands, 80m through 10m although 17m was slightly higher due to close proximity to the 80m 5th harmonic.

Of interest, this antenna should give you a near tune on the 6m band (sometimes perfect depending on exact length of the 40m element) however it should be noted that the far-field pattern will not be optimised for DX for this band.

Parts list

1. DX Commander 10m Pole
2. Ground plate 3mm aluminium
3. Radiating Plate 3mm aluminium
4. Guy Plate - 8mm Engineered Nylon
5. Upper Spreader plate - 5mm Nylon
6. Upper Double-Eye - 5mm Nylon
7. SO239 Assembly with flying lead
8. 18 x 6mm Bolts & Washers
9. 18 x Wing Nuts
10. 12 Fork Connectors (earth)
11. 10 Fork Connectors (elements)
12. 8 Hose Clamps (various)
13. Circa 90cms 8mm ID tubing
14. Small Section of 10mm tubing (new)
15. 1m x 3mm elastic shock cord 30cms long
16. 11m paracord
17. 12 Plastic Carabiners that snap together
18. 15cms (4 inches) of glue lined shrinkwrap

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.

In Detail

I have a user guide for the pole and you can find the user guide on the m0mcx.co.uk website under User Guides.

Ground Plate: This is made from 3mm aluminium with a single bend for the SO239 assembly.

The radiating plate is also machine cut from 3mm aluminium. I personally tap these holes to 6mm. You will find that the current series of wing-nuts that I'm using interfere with each other due to the close proximity of the holes. Rather than increase the diameter of this plate, the 2018 Mk3 version of this plate will have less holes. For instance, 9 wing nuts should be suffice for most users. It is possible to squeeze 6 radials per fork connector, achieving 54 radials (if you are that obsessive). Actually, you could double-fit 2 x fork connectors to each bolt giving you over 100 radials - but you will enter that mysterious world of serious diminishing returns! See later in this document where I discuss this in more detail.

The guy plate is probably the most expensive item on the parts list. It is made from a specialist Nylon material called UHMWPE and is 8mm thick, up from 6mm on the original version. This 50% increase in thickness has improved it's massive strength so that you should barely see any movement as you tighten the guys up.

The upper spreader (again, in UHMWPE) fits at around the 5m point. Again, the size of the material has been beefed up from 3mm.

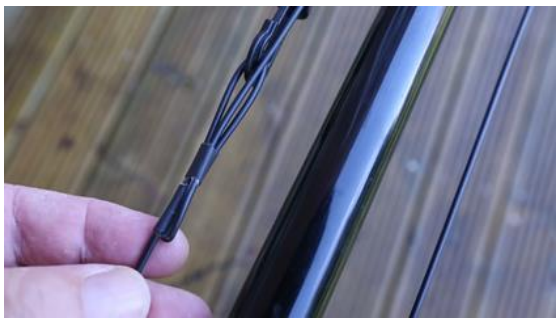
The Upper Double-Eye (UHMWPE) allows for the 40m element to pass through elegantly and the other hole may be used for either a 30m element or use this place to pass your 80m inverted L though.

The SO239 assembly comes with a flying lead. These are soldered to the SO239 and hot glue is applied. This assembly is then reheated with a 1500 degree heat gun to re-melt the glue and ensure a weather proof seal.

The hose clamps need to have the tubing fitted. Cut the 8mm id tubing into 7 pieces using a ruler and scissors: 12cm, 11.5cm, 11cm, 10.5cm, 9cm, 8.5cm and 8cm. Unscrew all the hose clamps and fit the tubing to the hose clamps. You may need hot water to assist. Fit the 12cm section to one of the large hose-clamps. Do not fit hose to the other one of the larger hose clamps. You will use this at the very bottom and it doesn't need the plastic protection or grip-factor of the ones we'll use further up.

Black plastic carabiner clips. These 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 10cms (4 inches) of shock cord per element and make the rest of the extension to your element with paracord. Note that these little carabiners, although an excellent solution, are difficult to un-snap, once their mated bodies (hook and base) are snapped together. You may therefore wish to snap these together only once you have settled in your mind, the element lengths, shock-cord lengths and applied the heat shrink. I apologise if I sound paranoid as I write this however it is better to be armed and get it right first-time rather than cause yourself anguish later on.

You will need to elegantly connect your shock-cord to the paracord. This gives your element a little “spring” to it. I am endlessly hunting down a crimp or some sort of connector to achieve this at a reasonable cost but have so far failed. In my original “how-to” films, I suggested a pair of bowline knots however I now recommend a “fishermans knot” and you’ll find plenty of how-to videos on Youtube of how to achieve this knot and it’s also really small and unobtrusive. And you’ll learn something new!



Connecting 40m: I make a small loop about 100mm (5 inches) down from the upper double-eye directly on the 40m element. Use glue-lined shock-cord to keep this loop stable - and small enough so that it will still fit through the Guy Plate and the Upper Spreader. Add a small section shock-cord and the carabiners to connect the 40m element loop to the Double-Eye - and continue the element right up to the top of the pole. This will stop your 40m element flapping about. PS – slip over a section of spare tubing to the top of the pole. This will secure your 40m element neatly.

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

ELEMENT PLACEMENT

Please take care to place the 40m element opposite the 30m element. The 40m element should be on one of the connectors opposite the feedpoint.

Secondly, I found that it was better to place the 17m next to the 40m element and place the 20m element opposite this 17m element (next to the 30m element). However, one user suggested he had an even better result doing the opposite. What ever you do, the 20m and 17m elements should be opposite each other to balance out the Upper Spreader. Placement of the 12m and 10m don't seem to mind where they are placed however they will need to be opposite each other. That will also balance out the tension all-around.

If you are only using 4 elements to achieve all bands, the 17m element and 20m elements will pull down on the upper spreader 180 degrees apart, giving you a more pleasant aesthetic "look" to your DX Commander. However, don't over tighten these. You only need very slight tension. Use about 5cms of shock cord only and don't over-stretch them. No need. The 20m element won't require any cord. You can go straight from the upper spreader to the 20m element in a single (small) run of shock-cord.

Note, you will be already achieving 40m, 30m, 20m, 17m and 15m with these 4 elements and software modelling in this configuration is showing that 15m is slightly better than I'd hoped for. This possibly explains my 15m score during the IOTA contest in July 2017.

ADDING 12m and 10m

If you are running an on-board ATU , you will find the SWR is not too high on these bands WITHOUT fitting these elements and you'll have to ask yourself if it's worth the effort, however purists and those who want full power through an amplifier may wish to add these elements to achieve better than 1.5:1 SWR on all bands. If you want to add 12m and 10m elements, place your 12m element next to the spare slot by 30m and 10m element opposite that (next to 40m).

TIPS

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?

Too much tension on your shock-cord will apply a serious downwards force on your pole, so if you feel you do have high tension, make sure your hose-clamps are well tightened. There's clearly a limit though since we don't want to crush the fibreglass pole tubing.

ELEMENT LENGTHS

Pure copper uninsulated 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. So how come our elements are less? Mine work at 4.88m long (with an additional fold-over of 6cm).

It turns out that the wire I use has a velocity factor of around 92.5% which is why we can cut the wire to 4.88m (and add on 6cms for the fold-over). Perhaps most insulated wire has a velocity factor of around 92%.

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

- 10m – 2.5m + 6 cms foldback (for the heat shrink loop)
- 12m – 2.83 + 6 cm
- 17m – 3.83m + 6 cm
- 20m – 4.88m + 6 cm
- 30m – 6.74m + 6 cm
- 40m – 11.06m (foldback back down pole and cut to tune 15m band perfectly)

- 80m (OPTIONAL) and replaces 30m element) 19.5m (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.

NOTE

- One user reported that the 12m and 10m elements were about 5cms too long with these dimensions. It may be possible, depending on local conditions that you can conceivable end up accidentally cutting an element too short. I suggest you therefore make up ***all*** your element 10cms longer anyway and not be tempted to apply the glue-lined heat-shrink until you are absolutely comfortable with the lengths after testing.
- 20m issue: I noted that by the time I have fitted a pair of carabiners (and some shock-cord) to the top of the 20m element, the shock-cord was too long to give me some "twang" to keep the element taught. You need to make this section of shock-cord as SMALL as you can. Alternatively, make the shock-cord longer and cut the 20m element 30cms (12 inches) longer too so that your "fold back" will top-load the 20m element. You can easily cut the spare off if it resonates too low in the band – or send it "north" like the 40m band element and tuck it up through the hole on the Upper Spreader.

DO I NEED AN ATU?

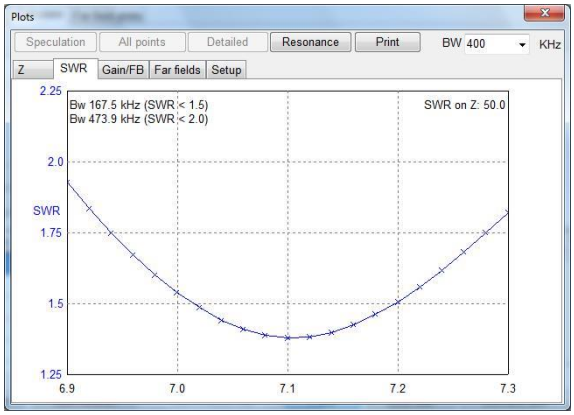
I'm still getting users suggesting to me they will use an ATU with the DX Commander ABV. Seriously, this is a waste of time. By configuring the assembly correctly, no ATU will be required. This is the whole ethos of the unit. I designed this originally for me alone, so I could run a power amplifier with no tuner in line and keep the radio hardware to a minimum. The history is that some of my friends expressed an interest in my new antenna and I ended up making 20 prototypes by hand before moving into low-scale production. This is genuinely an accidental enterprise.

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 a software 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(!).



USING 40m ELEMENT ON 15m BAND (¾ wave) [actually a 5/8th – read on].

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 – and physically it was too long for me, genuinely a ¾ wave.

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, so I could have made the fold-back slightly shorter.

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 15m 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 length of this 15m element is that it becomes a 5/8th wave physically. I believe this is why I achieved such a fantastic result on 15m band during the IOTA contest. Actually, I was surprised to discover that my 2017 IOTA score was the highest ever recorded from UK mainland for a low-power, 12 hour operator. I don’t think it was me personally, but the DX Commander. Nice work.

ADDING 80m

I successfully changed out the 30m element for a 19.5m long element as an Inverted L which tuned very well from 3.65 through 3.8, under 1.5:1 SWR for the IOTA contest. The vertical component is around 6.7m high, then just where the 30m element would have been attached, I changed course for the horizontal portion to a hedge which was only about 3m above the ground, so the element dropped downwards. My 80m IOTA score was great on 100W and I did not use the ATU function on my radio. Beware that your DX Commander will lose it’s visual appeal when you see it bending over, with some slight sideways pressure from the horizontal wire, but hey, it works :)

There’s some good news and bad news in this configuration: The good news is that 30m is a very near third harmonic of the 80m element so you do get to keep that band with your ATU engaged. Had I tuned the 80m inverted L for lower in the band, I might have found that the 30m SWR may have been a perfect match. In the configuration I created though, SWR was 4:1. My TS590 easily tuned this slight mismatch out. Making the 80m element longer would have probably pulled 30m inside a 2:1 SWR envelope, possibly better.

The bad news is that the 17m band is also a very near harmonic of the 80m band and my SWR rose here since the longer inverted L wanted to take over and I noticed a pure 1:1 match about 1 MHz down from where I wanted to settle on 17m. It was still useable but I suppose there is always a compromise. To conclude, it might be better to cut the 80m element 75cms longer down towards the CW end of 80m and maybe only the ATU for the SSB portion of the band on 80m? Of course, 80m always has this issue since in percentage terms, it’s a very wide band. However, forcing the 80m element further “south” will have allowed the 17m element to perhaps tune up properly. I did not try that experiment though.

Regardless of this 80m configuration, 17m may be your “recalcitrant” element. I am often left bewildered why I can’t quite get the SWR right down below 1.6:1 here. Software modelling is not showing an issue with this band, so maybe someone one day will find a solution to settle the argument. Even increasing / decreasing the diameters of all the plates (in software) doesn’t show an issue and there are no elements that harmonically relate, so I’m slightly flummoxed. Your mileage may vary. I just hate ATUs on coax!

GLUE LINED SHRINK WRAP

Find 6 inches of this in your kit. You only need 6mm (1/4 inch) per element to make your loop for the carabiner to connect to. Only fit once elements are correct because once fitted, they are a nightmare to get off. 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

I’m gradually moving to three sizes of hose clamp, large, medium and smaller. Obviously, the larger ones go near the bottom and the smaller ones at the top. Of interest, I forgot to tension mine up during IOTA contest for my holiday and the DX Commander still stood up for a fortnight without any real clamping. So I’m slightly confused how to proceed here. It adds lots to the price of the kit but I’m inclined to suggest you do fit them and go through the hassle of cutting and fitting the tubing to each clamp. If you find your results vary from mine in this department, please let me know. Certainly the very bottom one (no tubing required) is required to hold the radiating plate from rising upwards and I think you should almost certainly fit one just above the guy plate too since that has a lot of pressure.

RADIALS

Your starter kit will give you at least 70m of spare wire after you have built the elements. Use this to build 20 x 3.5m radials in 4 bunches of 5 radials. To give you more confidence, you may also enjoy my paper here:

http://www.m0mcx.co.uk/vertical-antenna-how-many-ground-mounted-radials-do-i-need/

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 – obviously for insulated wire.

Upon further investigation, it transpires that nobody has really done the hard field work to settle this argument. The portion of the element that is folded back, will have an impact on your tune. If you happen to have already done the field-work, please let me know. I will conduct my own tests too.

I mention this because this whole topic of the 40m/15m discussion and why my “boomerang match” works may rely on it – and may even be frequency dependant.

FIRST-TIME ASSEMBLY

Slip over the Radiating Plate down to bottom of pole and attach a Hose Clamp here to stop of wobbling about. Don’t over-tighten. Extend only the second largest section of the pole and slip over the Guy-Plate.

Hammer thee guy stakes into the ground, about 2.5m (8 feet) in diameter, 120 degrees apart from where the centre of the mast will end up, 120cms from the centre. Connect 2.5m of paracord to each guy.

Test-erect by resting this stubby arrangement on your shoulder and loop the guys around each of the guy stakes and tie off to the Guy Plate. Adjust to suit. Of course, you can erect the whole telescopic arrangement when you do the test-fit, but you’ll find it easier if most of the pole is inside the bottom tube). Now release only one guy point and lay on ground. Tip: Use a bowline knot to tie your guys to the guy stakes and use an Alpine Butterfly knot 75% up towards the guy plate. Loop your guy rope through the guy plate and then use the Alpine Butterfly at a pulley. Tie off with some Half Hitches. I am about to do a video on knots, so check out my YouTube channel for this tutorial.

Unscrew the bottom of the pole and fit the ground plate to the thread and re-tighten the base. **Optionally**, you may want to leave the ground plate directly on the grass for ease of removing or lowering the mast when your radials are connected (else, when you lower the mast, your neat and carefully arranged radials end up going everywhere!). The thread on the bottom of the plastic is pretty coarse, so have some empathy when you re-tighten the thread.

Slip over the 8mm heavy guy plate so that it fits on to the top of the first section. Use the larger hose clip with the 12mm hose above the first guy point. Do not over-tighten. Continue for the next few sections fitting the hose clips ABOVE each joining section to stop the sections collapsing.

Test fit the upper guy-point spreader and again, use a rubber coated hose clip above the spreader as you did on the lower spreader. Use up all the hose clips. The last few section do not need any clips.

Using the 6mm bolts, washers and wing nuts, fit the radiating elements at the bottom and thread each vertical through an appropriate hole in the spreader plates. **NOTE**: Fit the 40m element to one of the holes opposite the feedpoint. The feedpoint can be identified because it is the middle of three holes closer together.

Once you can judge the element lengths, prepare some shock cord of appropriate length and tie these to the upper spreader (40m and 30m will not require tying off here). Connect a small amount of paracord to the elastic and fit a cord-end ball.

If you wish to use a 30m element, thread it through the upper guy spreader and use some shock-cord and some paracord at the 7m height hose clamp to keep upright. On the opposite side, thread the 40m element through.

Raise the whole pole vertically and check you have moderate to low tension on the wires to keep them from blowing about too much.

Guy off the vertical and connect the rest of the radials.

Fit the SO239 connector and slide the radiating plate into position.

Go test!

Permanent Use

I never created the DX Commander system for permanent use. It was a “toy” for me as a reliable, repeatable holiday antenna. However, many people are asking me if it will work over the long term. The real answer is that I don’t know. The weak-point will eventually be the pole itself (storms, ice, etc). However, a replacement pole is cheap. I sell a lifetime replacement service for a broken pole at circa 66% of new. The rest of the components should last many years. I specify black paracord and shock-cord for UV protection, however I am guessing these will eventually lose either flexibility or strength – but they shouldn’t be under that much tension anyway.

Of interest, I am just about to build a DXC10ABV as a long-term test for this reason at an operator’s house who has a long garden and we’re hiding it at the bottom. I intent to use fibreglass resin on each joint to remove the requirement for hose clamps. Other than that, I’ll use the standard components. Hopefully I’ll be able to report back some day.

Good luck,

Callum M0MCX