DXC10mABV User Guide Version 1.6 June 2019

Congratulations on the purchase of your DX Commander 10mABV multi-band 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 multiple vertical 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.

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 will require inbuilt ATU if using 80m element).

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) achieved way-better than 1.5:1 SWR across all bands, 80m through 10m.

Of interest, this antenna should give you a perfect tune on the 6m band (depends on exactly where you tune combination of 40m and 30m band) 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 10m Pole
2. Ground Plate 3mm aluminium
3. Radiating Plate 3mm aluminium
4. Guy Plate - 8mm Engineered UHMWPE
5. Mid-Spreader UHMWPE
6. Upper Spreader Plate - 5mm UHMWPE
7. Upper Double-Eye - 5mm UHMWPE
8. SO239 Assembly with flying lead
9. Appropriate number stainless bolts
10. Appropriate number stainless wing Nuts
11. Plenty of Fork Connectors (earth)
12. Plenty of Fork Connectors (elements)
13. Hose Clamps (XL, L, M & S)
14. Circa 90cms 10mm ID tubing
15. Small Section of 6mm & 12mm tubing
16. Length 4mm elastic shock cord
17. Paracord for guys & element extensions
18. 12 Plastic Carabiners that snap together
19. 15cms (4 inches) of glue lined shrinkwrap
20. 100m (new) DX10 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 and you can find the user guide on the website under User Guides. The pole extends to around 9.3m 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 9-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. Note - aluminium components: These often come from the cutting factory in a bit of a state, and after tapping out the holes, can have cutting oil on them too. I often put them in the dishwasher to clean them up, however they may end up looking tarnished. If you are as

OCD as me, you might like to emery-paper the edges and even polish the tops of the Plates. They come up a mirror finish, however after a couple of months, aluminium oxide will again form on the surface, sealing-in the magic! You don't need to be concerned about the look unless you like polishing metal :)

The Guy Plate is an expensive item on the parts list. Fits at the 1.2m (4-feet) point. This is now manufactured in 8mm natural UHMWPE (up from 6mm) which is extremely substantial. Holes are the right size to fit elements (3, 4 or 6) and the guy point will allow 6mm carabiners 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. Having a 33% increase in plate thickness means much less bend too.

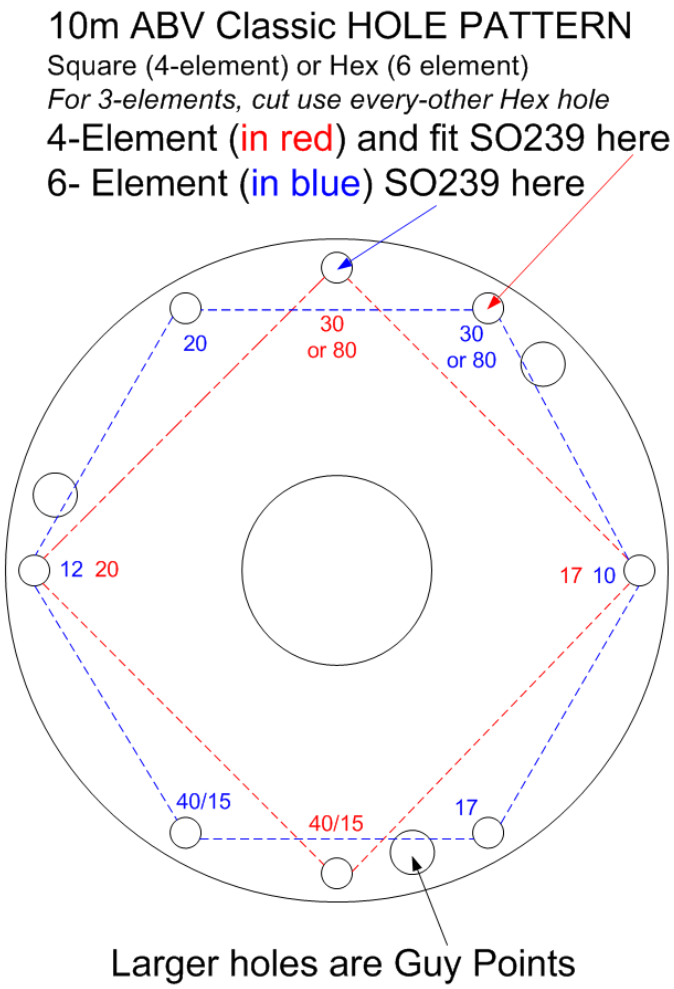
Mid Spreader: I was never quite comfortable with the lengths of the elements waggling around in the wind. The Mid-Spreader holds your elements firmly. It's 5mm UHMWPE nylon. You can connect your 10m and 12m elements directly to this, saving yourself some paracord. Fits two clear sections above Guy Plate.

Upper Spreader: I was never quite comfortable with the 3mm thick upper spreader. It had too much bend and didn't look quite right. I have now specified this at 6mm and it is much more substantial. I'm delighted with the result. Fits another 2-sections above the mid-spreader

The Upper Double-Eye (7m point) allows for the 40m element to pass through elegantly and the other hole is used for either a 30m element or use this place to pass your 80m inverted L though (either/or).

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 and a fork-connector is fitted.

The hose clamps need to have the tubing fitted. Cut the 8mm id tubing into 7 pieces using a ruler and scissors: Approximately, these sections are: 2 x 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 use hot water to assist, depending on hose and clamp size. Fit the 12cm section to the XL hose-clamps.



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 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: Connecting 40m: I make a small loop about 100mm (4 inches) down from the Upper Double-Eye directly on the 40m element, next to the 30m end. Use glue-lined heat-shrink to keep this loop stable - and small enough so that it will still fit through the nylon Plate holes. 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 keeps the 40m element nice and taught - and balances the 30m element tension.

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

Before I discuss the components, 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.

If you are only using 4 elements (see page 2. for element placement) 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. The 20m element won't require any paracord. 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 further 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. You can connect the 10m and 12m element to the Mid-Spreader.

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.

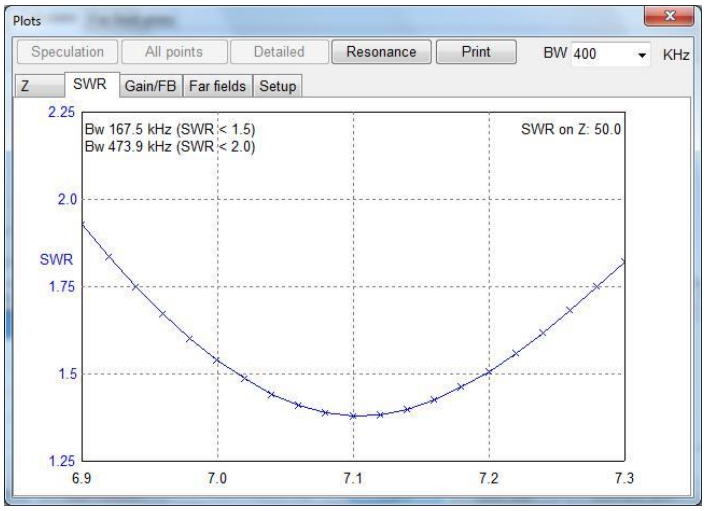
For instance, the wavelength for 14.225 MHz is 21.09m long (not 20m). A mathematical quarter wave of this will be 5.27m. It turns out that the wire I use has a velocity factor of around 93-94% which is why we can cut the wire shorter.

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)
- 12m – 2.78m + 6 cms foldback
- 17m – 3.83m + 6 cms foldback
- 20m – 4.82m + 20 cm (longer folder compensates for slightly shortened element)
- (OPTIONAL: 20m – 4.88m + 6 cm – if it'll fit - depends on version of pole)
- 30m – 6.74m + 6 cm
- 40m – 11.15m (foldback back down pole which will also give you physical 5/8th for 15m)
- 80m (OPTIONAL) and replaces 30m element) 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.

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 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 :). Update 2018: Less tension means you should hardly notice any bend.

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. And 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 at 10.1Mhz, dropping to resonance at 10.6Mhz. My TS590 easily tuned this slight mismatch out. Making the 80m element longer would have probably pulled 30m inside the 2:1 SWR envelope I prefer to work at.

I've had mixed results with 17m band because the longer elements is a near harmonic of the 80m band and initially (during 2017 tests) my SWR rose here since the longer inverted L wanted to take over and I noticed a pure 1:1 match about 500kHz down from where I wanted to settle on 17m. It was still very useable though. During my 2018 tests (Cornwall Holiday), I found that although I was getting resonance as detailed above, I was also getting another SWR dip bang on where the 17m band tunes. Perhaps making the 17m element a couple of centimetres shorter assisted. I'm only alerting you to this for completeness.

80m Note: make up your element, just like the 40m band by creating a small loop, just under the Double-Eye and use some shock-cord here with a pair of Carabiners. This works well and stops you from over-tightening the element and ensures the hard right-angle that the 80m element would have to make is reduced.

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

I supply 4-types of hose clamps, XL, L, M and S. 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 result vary from mine in this department, please let me know. Certainly the bottom one is required to hold the Radiating Plate from rising upwards and I think you should almost certainly fit one just above the guy Plate.

RADIALS

The wire in your starter kit will give you around 70m of spare wire after you have built all your elements. Use this to build 20 x 3.5m radials in 4 bunches of 5 radials. Effectively, this is 2-wavelengths of radials at 40m band and 4-wavelengths for 20m band. Plenty. If you want to add 80m, find some very light-weight "equipment wire" unless you purchased the right amount from me in the first place.

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. Twist and lightly solder 6 radials together. Snip and insert to a fork connector. A proper set of wire-strippers helps here.

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

Hammer thee 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 one of the larger hose clamps to stop it from slipping around. Do not over-tighten.

Slip over another XL hose-clamp and tighten just above the first section-join (don't over-tighten, just enough that you can't rotate the clamp). Now slip over the Guy Point. If you fit the components this way around, tightening the clamp is easier else the guy point gets in the way). Continue for the next few sections fitting the hose clips ABOVE each section-join to stop the sections collapsing in inclement weather (these Upper hose-clamps are not mandatory for occasional use or testing).

Fit Mid-Spreader and appropriate hose-clamps.

Test fit the Upper Spreader (which can act as an optional Upper guy-point for severe weather) and again, use a rubber coated hose clip below the Spreader as you did on the guy point. Use up all the hose clamps. The very last couple of sections do not need any hose-clamps and are not supplied.

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. **NOTE**: Fit the 40m element to one of the holes opposite the feedpoint. The feedpoint can be identified from diagram on page 2.

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..

The 30m element will require only shock-cord and no paracord. Connect this to the Upper Double-Eye.

For the 40m element, make a small loop, approximately at the same point the 30m element loop has been created. Use a small section of shock-cord (and 2 x carabiners) to keep the 40m element taught up to at least the 7m Double-Eye.

> Continue right to the top, go through the little metal eye and back down again the other side. Your element should approximately end near the join of the second to last section, ideally a little longer.
>
> Cut in half, the small section of the larger diameter tubing that is supplied and slip that over the top of the pole. It should snugly hold the 40m element in place. You may need 1 wrap of electrical tape to stop it waving around in the wind.
>
> Again, reserve a small section of the tubing we used for the hose-clamps, and slip this over too. 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

Permanent Mounting Thoughts

I didn't originally design this for permanent use, but the joy of using one encourages us to hunt down solutions to installing permanently.

Previously, I have successfully used epoxy resin on each section to eliminate the hose-clamps and drop the whole assembly over a 44mm (1 3/4 inch) aluminium tube. Note that extra pressure will now be exerted on a) at the point where the aluminium tube stops inside the pole and b) there will now be more force on the join between the bottom section and the second section that in time may weaken and fracture. I have fitted hose clamps to both these areas to help out the structure.

Note: A waterproof, soft glue might be better between sections - rather than an epoxy which can harden and crack.

Further, you can use the Upper-Spreader as a mid-way guy point.

Weather-proofing for very long-term testing: The hot-glue on the SO239 can gradually break-down where it meets the wire. Water ingress can occur and in time, corrosion to the wire.. You can protect this by wrapping a small piece (2.5 cms / 1 inch) of self-amalgamating tape on the wire where the hot-glue stops.

If you are using near salt-water, 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