

M2 Antenna Systems, Inc. Model No: FG40M2-MINI



SPECIFICATIONS:

40M2-MINI
7.0-7.3 MHz
10.6 dBi @ 70ft.
22 dB @ 70 ft
HAIR PIN /1:1 Balun
50 Ohms
120kHz, 2:1 BW.

Power HandlingBalun dependentBoom Length / Dia245" / 2.0/2.5" X .065Maximum Element Length38'Turning Radius:21' 7"Mast Size2" or 3" Nom.Wind area / Survival5.1 Sq. Ft. / 80 MPHWeight / Ship Wt.45 Lbs. / 50 Lbs.

*Subtract 2.14 from dBi for dBd / FS = Free Space

FEATURES:

The New **40M2-MINI** is an exciting, reduced size 2 element 40M antenna. The elements have been reduced in length with the use of our new air coil along with a new recently designed capacity hat just past the coil. The result is a **REDUCED SIZE** element, just 38 ft long. The **40M2-MINI** uses simple element tip adjustments for optimizing performance for any part of the 40M band. **M**² Engineers have reduced the total length of all the element and boom tubes to under 46 inches. This keeps the shipping box to under 48" for reduced shipping costs. Many customers outside the US can easily obtain 50MM or 75MM tubing for home brewing their own antenna boom. So keep your eye out for the foreign model **40M2-MINI -F** with all the parts needed, just without the boom material. The **40M2-MINI** uses all of the same high quality hardware and machine parts that all of customers have come to know. Don't miss the best part of the cycle, contact M2 for some help today

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40M2-MINI ANTENNA OVERVIEW

BEFORE YOU BEGIN: Look over all the DRAWINGS to get familiar with the various parts and assemblies in the system. Tools handy for assembly process: screwdriver, 11/32", 7/16", 1/2", 9/16" and 5/8" spin-tites, end wrenches and/or sockets, and a measuring tape.

Note:

All installations are unique in some way, which means it's OK to preassemble certain hardware, or rearrange the assembly process to meet specific site requirements. A quick review of the assembly drawings should help firm up the appropriate strategy. Please remember to double-check all hardware for tightness BEFORE it becomes inaccessible.

One container of zinc paste (Penetrox, Noalox, or equiv.) has been provided to enhance and maintain the quality of all mechanical and electrical junctions on this system. Apply a thin coat wherever two pieces of aluminum come in contact or any other electrical connections are made. It is also useful on screws and bolt threads as an ANTI SEIZE compound.



40M2-MINI ELEMENT HALF OVERVIEW





40M COIL OVERVIEW



40M COIL ASSEMBLY INSTRUCTIONS

<u>STEP 1:</u>

The coil comes wound tight with 16 total turns from the factory. When final assemble is complete, you will end up with 15.5 total turns. The excess material will be trimmed off after the coil is in its final position. Using a permanent marker, draw a straight line from one end of the coil to the other. This will help later to determine if your coil has grown in diameter during assembly. After final positioning of the coil, no more than 3/4 of an inch of line tilt is allowed. A larger coil will cause the inductance to change which can cause your antenna to be off frequency.

STEP 2:

The COIL is wound tight at the factory to prevent damage during shipping. Use the COIL SPREADING TOOL provided and carefully insert it into the first turn of the COIL. Now gently push or roll the tool through all 16 turns of the COIL. Now the COIL is nearly in its final shape and is ready to be threaded onto the COIL SUPPORT. Note the reference line drawn earlier, it will have a slight tilt after spreading.

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STEP 3:

On one end, use pliers to gently straighten the last 1/2" of the COIL and file off any burrs.

STEP 4:

Begin threading the COIL onto one end of the COIL SUPPORT. **BE CAREFUL** to not deform the COIL during this process. The COIL should thread smoothly. Continue until about 5-1/2 turns are past the COIL SUPPORT or close to the center. Exact centering is not important. Again, note your reference line.



NOTE: PENETROX PASTE FOR LUBRICATING SCREW THREADS AND TUBING JOINTS HAS BEEN SUPPLIED. USE A VERY SMALL AMOUNT ON EACH SCREW THREAD AND UNDER THE COIL POSTS DURING THE NEXT OPERATION.

STEP 5:

Insert the COIL INSULATOR (M2AFG0050) into your COIL SUPPORT (M2ACA1554). Rotate the COIL and the COIL SUPPORT so the leading end of the COIL goes over and just past the inner hole in the COIL INSULATOR. Now slide on one COIL POST on to one end of the COIL so it is right over the first hole. Next, carefully slide on the ELEMENT SECTION #6 (M2AEP40MC-6) and align it so both holes in the tube match the two holes in the COIL INSULATOR.

<u>STEP 6:</u>

Insert hardware through the ELEMENT SECTION #6 and the COIL INSULATOR and begin threading it into the COIL POST. Tighten hardware. Thread the SET SCREW into the top of the COIL POST and with about 1/2" of wire protruding past the COIL POST, tighten the SET SCREW gently. Use supplied ALLEN WRENCH to tighten the SET SCREW.

40M COIL ASSEMBLY INSTRUCTIONS

<u>STEP 7:</u>

The second COIL POST is mounted on the OPPOSITE SIDE of the COIL INSULATOR, so 15 1/2 turns of the COIL are used. The extra 1/2 turn COIL should pass over the COIL INSULATOR hole. Slide on the second COIL POST and align it over the hole. Slide on ELEMENT SECTION #7 (M2AEP40MM-7) and fasten the COIL POST to the tubing assembling using the supplied hardware. Use you reference line and adjust the coil so the line has no more tilt than 3/4". There should be about 1 1/2" to 2" of extra coil material past the post after adjusting that will be trimmed.

STEP 8:

Insert the SET SCREW into the COIL POST and tighten gently. Adjust the COIL and COIL SUPPORT location for equally spaced turns. The distance between each turn should be the same as the COIL wire diameter. Once the COIL is straight and aligned, tighten the final SET SCREW



securely. Trim off excess coil material leaving 1/4 to 1/2" past the COIL POSTS.

STEP 9:

Slide COIL COVER and COIL END CAPS onto COIL ASSEMBLY. Secure COIL END CAPS into position by securing hardware through TUBE ASSEMBLIES on both ends of the COIL ASSEMBLY. Slide ELEMENT OVERHEAD SUPPORT onto ELEMENT SECTION until it reaches the head of the screw holding on the COIL COVER.



STEP 10:

Assemble all the remaining COIL ASSEMBLIES by repeating steps 1-9. Set COIL ASSEMBLIES aside for future use.

40M2-MINI BOOM ASSEMBLY INSTRUCTIONS

STEP 11:

At this point it will be helpful to perform the remaining assembly steps with the BOOM ASSEMBLY elevated off the ground (about 3 feet). This can be accomplished by using sawhorses or something similar. Wipe off the swedged ends of each BOOM SECTION and apply a small amount of PENTROX. Refer to the drawing below and assemble BOOM SECTIONS as shown. Insert hardware and tighten.



STEP 12:

Add the eye bolts into the open hole on boom sections 1 and 6.



40M2-MINI ELEMENT MOUNT ASSEMBLY INSTRUCTIONS

STEP 13:

Assemble the ELEMENT MOUNTS AND FRIST ELEMENT COMPONENTS TO THE ANTENNA BOOM. Refer to the assembly drawing to aid in assembly.



STEP 14:

Assemble the DRIVEN ELEMENT MOUNT assembly for the DRIVEN ELEMENT. Refer to the assembly drawing to aid in assembly. Refer to the dimension sheet for element spacing.



STEP 15:

Slide the pre-assembled coil assemblies onto each end of the center sections of each element and add the cap hat clamp and hardware. **Position the clamp at 1**" from the coil end cap and tighten the hardware. Center the cap hat rods on the clamp and add the cap hat cap and hardware. With the rods centered, hand bend each end of the rod up to an approximate angle of 45 deg. Loosen the cap hardware and tilt the rods over the coil to where the rod tips are over the coil inner cap and tighten the cap hardware.



40M2-MINI ASSEMBLY INSTRUCTIONS

STEP 16: Continue adding the remaining tubes to each element, refer to the "element half overview" for tube sizes and hardware call outs. Note the tube overlap at the 3/4" and 1/2" tube sections uses a 3" overlap. Refer to the dimension sheet for the 3/8 tip exposed amount.

STEP 17:

Add the hair pin tubes and remaining components, see drawing below for hardware call outs.



40M2-MINI HAIR PIN AND BALUN ASSEMBLY INSTRUCTIONS

<u>STEP 18:</u>

Refer to the dimension sheet for element placement. With the boom elevated on sawhorses or equivalent, using a long tape measure and a permanent marker lay the boom out by marking the centers of each element. Equalize the amount of extra boom at both ends on the antenna.

<u>STEP 19:</u>

Install each element at the marks on the boom. Be sure the eye bolts in each end of the boom are in the up position. Double check the positions of each element and lightly tighten.

STEP 20:

Standing at one end of the antenna, sight down the boom and reference each element to one another making sure each element is parallel to one another, make small adjustments as needed and tighten.

STEP 21:

Assemble the BALUN and feed system of the antenna. Refer to the dimension sheet and DRIVEN ELEMENT assembly drawings.

OVERHEAD BOOM SUPPORT DETAIL:

Dacron rope (5/16), turn buckles and thimbles have been supplied for the overhead support. Use knots at each ends of the rope at the eye-bolt on the boom and at the turnbuckles at the turn buckle plate. After your knots, tape the tail end of the rope to itsself to prevent loosening.





Two Half Hitches

40M2-MINI DIMENSION SHEET



40M2-MINI TIPS AND TRICKS

This is a balanced antenna as most Yagis are. When the hairpin or beta match is used to bring the feed point to a 50 ohm impedance, the use of a 1:1 balun of some form is required. M2 can supply 1:1 baluns for several power handling levels. A standard would be a 1:1 balun capable of easily handling 1.5 kilowatts. Many sources of good quality baluns exist and we will also provide you with two common "home brew" balun designs. We also have provided #43 farrite cores so you can fabricate a home brew balun.

FARRITE CHOKE BALUN: The 1:1 balun can be achieved by first breaking out the shield and center conductor for about 4 inches of your good quality, 50 ohm feedline. Trim the length of the two leads to reach the feed bolts on top of the hairpin clamps. Add two ¼" hole solder lugs to the lead ends. Now seal the coax cable at the breakout to prevent any moisture from entering the cable around the shield. Water here is your enemy and will damage or deteriorate the cable performance and probably affect the VSWR of the system. Once the cable is sealed, slide on the 5 large 1/2" hole #43 ferrite bead cores supplied. Secure the cores up against where the cable leads break out by using tape or a large nylon tie. Beads don't mind water but they should stay securely at this point on the cable/ balun assembly.



COAX COIL BALUN: Another simple 1:1 balun can be achieved by first breaking out the shield and center conductor for about 4 inches of your good quality, 50 ohm feedline. Trimming the length of the two leads to reach the feed bolts on top of the hairpin clamps. Add two ¼" hole solder lugs to the lead ends. Now seal the coax cable at the breakout to prevent any moisture from entering the cable around the shield. Water here is your enemy and will damage or deteriorate the cable performance and probably affect the VSWR of the system. Once the cable is sealed, coil up 8 turns in a 8" to 10" diameter coil and tape or cable tie the assembly so it will stay coiled up and taped to the boom next to the feed.

BADGER BALUN: Another very good broadband 1:1 balun can be built using a design by George Badger from EIMAC. George wrote two very good articles in Ham Radio magazine in the mid '80's. If you like home brewing with superb end results, we can highly recommend the badger balun. Details should be available on line.

TUNE UP DETAILS:

Once your **40M2-MINI** is in the air, you may have to "tweak it" slightly for your ground conditions and the antenna height. The antenna went through extensive testing at the M2, K6MYC 40 acre test facility and at several heights. As with any antenna, height above ground has the most effect on VSWR. At low heights of 20 to 40 feet, the VSWR and performance like front to back will be lower in frequency than when the height is 70 to 90 ft. Our testing showed the antenna moved up in frequency about 20 kHz going from 40 to 90 feet. Extensive modeling and repeated testing confirmed this shift. We also noted that the performance characteristics move about 20 kHz, up or down if we lengthened or shortened the element tips on both elements by one (1) inch or 25 mm. Stated simply to go up 20 kHz, shorten the tips by 1 inch on each side of both elements. To go down by 20 kHz, lengthen the tips by 1". It holds pretty close for 100 kHz, lengthen or shorten the elements by 5".

Unless you do something really radical, no adjustment of the hairpin should be needed. The <u>reflector</u> is very key to bandwidth and front to back. Another little known fact is that front to back, for 2 element Yagis, varies greatly at various heights over ground. At 40 feet you may only see 10 to 15 db f/b, but the yagi at 70 ft can show almost 25 db f/b. At 40 feet the 2 element Yagi pattern will show a very large bulbous lobe going almost straight up along with the normal front and back lobe shapes. Reflector tuning or spacing has very little effect on this bulbous overhead lobe. When receiving high angle signals from a close by station may only show 8 db of front to back. Raise the antenna to 70 ft and that high angle signal will drop to 20 db or more! So if at all possible, we recommend an operational height of 70 ft. Gain also increased by 1.8 db or so from 40 ft to 70 ft.

TO USE AS A DIPOLE: When not using a reflector, the resonant frequency will change, the hairpin should still be used at 39 inches for the best match. At low heights like 40 feet the dipole will radiate almost straight up as compared to a 50 degree radiation angle for the 2 element Yagi at 40 ft. Bet you didn't know that!

GENERIC COMPRESSION CLAMP DETAIL



40M2-MINI PARTS & HARDWARE

DESCRIPTION Q	TΥ
300M SECTION #1, 2.0" X .065" X 46" (M2ABS40M2MINI-1)	.1
300M SECTION #2&5, 2.0" X .065" X 46" SOE (M2ABS40M2MINI-25)	.2
300M SECTION #3. 2.5" X .065" X 46" SBE (M2ABS40M2MINI-3)	.1
BOOM SECTION #4, 2,5" X, 065" X, 46" SOF (M2ABS40M2MINI-4)	1
SOOM SECTION #6, 2.0" X, 065" X 34" SOE (M2ABS40M2MINI 4)	1
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ELEMENT SECTION #2. 1-1/4 X.050 X.40, SOE (MAREPUMIM-2).	.2
ELEMENT SECTION #3: 1-1/4 X 038 X 46 , SOE (MZAEP40MM-3)	.2
LLEMENT SECTION #1: 1-1/8" X .058" X 10" (M2AEP40MM-1)	.1
ELEMENT SECTION #4: 1-1/8" X .058" X 5" (M2AEP40MM-4)	.2
ELEMENT SECTION #5: 1" X .058" X 5" (M2AEP40MM-5)	.2
ELEMENT SECTION #6: 1" X .058" X 46" (M2AEP40MM-6)6)	.4
ELEMENT SECTION #7: 1" X .058" X 24" SOE (M2AEP40MM-7)	.4
ELEMENT SECTION #8: 3/4" X 049" X 46" SOF (M2AEP40MM-8)	4
	1
LELIMENT TID ASSEMDELY 2/0"Y 040"Y 40" (M2AEL HOMMA 10)	. 4
ELEIMEINI TIF ASSEMBET, 3/6 A. 049 A 40 (INZAEF400001-10)	.4
CAP HAT ROD, 3/16 X 46 UNBENT (MZAEP40/MM-11)	.8
HAIR PIN TUBE, 3/8 X .049 X 42" (M2AEP40MM-12)	.2
CAP HAT CLAMP, 3/8 X 1.25 X 2.188, (M2APL0033)	.4
CAP HAT CAP, 1/4 X 750 X 1.25, (M2APL0067	.4
NSULATOR, 7/8" X 14.75", FIBERGLASS ROD (M2AFG0049)	.1
DUAL DIAMÉTER MOUNTING CLAMP625 X 1.125 X 4.0" (M2AEC0205)	.2
DUAL DIAMETER MOUNTING CRADIE 625 X 1 125 X 4 0" (M2AEC0206)	2
	1
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300M TO MAST PLATE, 6 X 8 X .188 , ALUMINUM (MZAP10036)	.1
PENETROX / ZINC PASTE CUP	.1
ASSEMBLY MANUAL	.1
BAG #1	
40M COIL, 15 1/2 TURNS (M2ACA1550)	.4
COIL POST500" X .500" X 1.187". ALÚMINUM (M2ACA1551)	.8
COIL END CAP 4 465" X 625" LIMHW (M2ACA1559)	8
	1
	.4
	.4
	.4
COL SPREADING TOOL, 5/8" X 2", DELRIN (M2ACA1558)	.1
BAG #2	
2" U-BOLT & CRADLE	.5
2 1/2 U-BOLT & CRADLE	.2
TURNBUCKLE, 5/16" H&E ZINC	.2
THIMBLE 5/16 LIGHT DUTY ZINC	4
EVE BOLT 5/16 X 4"	2
	. 2
	4
	.4
COMPRESSION CLAMP, 5/8 (MZAMC0146)	.4
CLAMP BLK, 3/8 (HAIRPIN) (M2AMC0261)	.4
SHORTING BAR,1/2 X 5 (M2AHP0262)	.1
SPACER, HF HAIR PIN, 3/8 X 1" ALUMINUM TUBE (M2ARS0010)	.1
3AND CLAMP, #32 W/ HOLE (M2ADP0209)	.1
FARRITE BEAD, #43 1.05 X1.0 (MAG10000160)	.5
BAG #4	
NUT 5/16-18 SS	16
	11
	. 14
50LT, 1/4-20 X 4 , 55	.4
50L1, 1/4-20 X 3 , 55	.2
30L1, 1/4-20 X 2-1/2", SS	.10
30LT, 1/4-20 X 2", SS	.1
30LT, 1/4-20 X 1", FH SCKT SS	.4
SET SCREW, 1/4-20 X .250", SS	.10
-OCKNUT, 1/4-20, SS	.21
BAG #5	
SCREW 8-32 X 1-1/2" SS	12
	24
JUNEW, 0-02 A 1-1/4, JO.	.24
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NU1, 8-32, 55	.8
LOCKNUT, 8-32, SS	.28
ALLEN HEAD WRENCH, 1/8"	.1

OPTIONAL ADD ON KITS

OPTIONALBALUN ADD ON KIT BALUN, 1:1 5 BEAD, (FGBL0500) BALUN MOUNT PLATE, 1/8 X 2 X 4 (M2APT0014) 1.5 U-BOLT AND CRADLE 2.0 U-BOLT AND CRADLE	QTY 1 1 1 1
HARDWARE NUT, 5/16-18 SS LOCKWASHER, 5/15	4 4
OPTIONAL ELEMENT OVERHEAD SUPPORT KIT (FG40M2MINIEOS)	QTY
VERTICAL RISER ANGLE PLATE	2
EYE BOLT, 1/4 X 2.5	2
2" U-BOLT AND CRADLE	2
THIMBLE, 3/16 ZINC	8
DACRON ROPE, 3/16 X 22 F I	2
HARDWARE	QTY
BOLT, 1/4-20 X 4.5 HX HD SS	2
BOLT, 1/4-20 X 1.25 HX HD SS	4
LOCK NUT, 1/4-20 SS	8