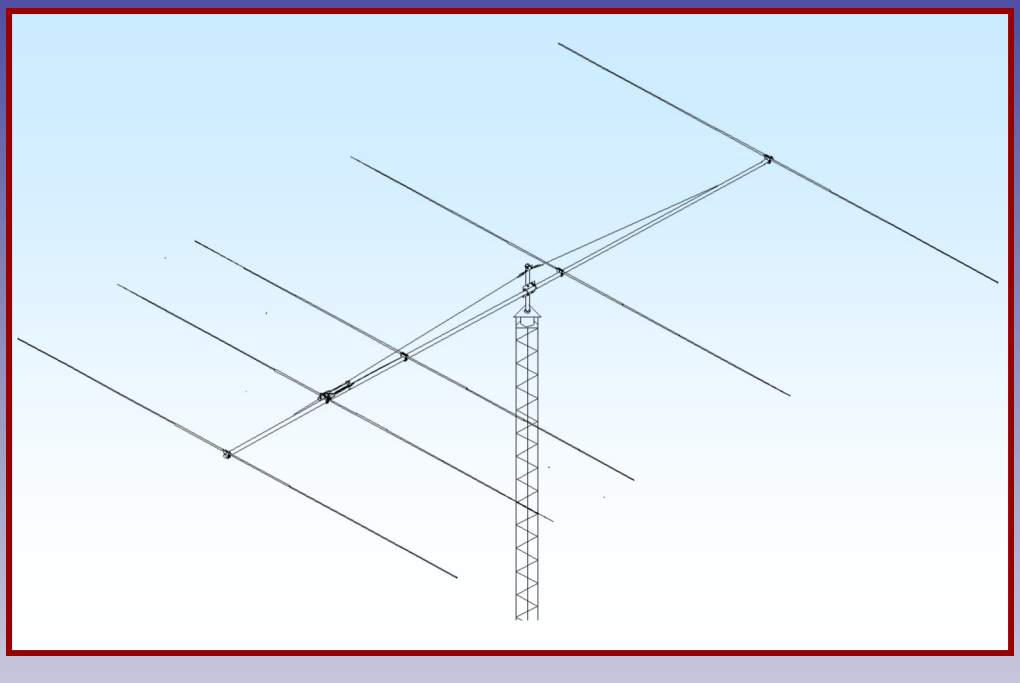
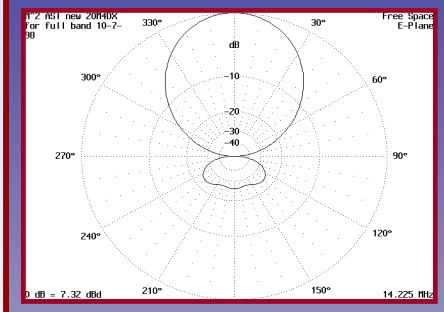
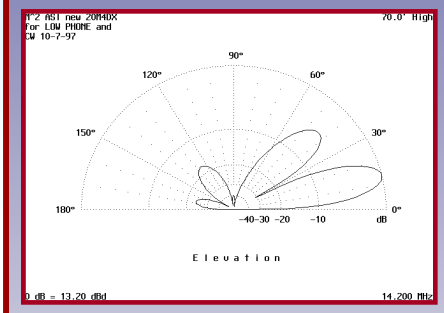
M2 Antenna Systems, Inc.
Model No: 20M5-125







SPECIFICATIONS:

Model	20M5-125
*FR / (G) FS / (G) OG	14.0-14.350 / 10.2dBi / 15.8dBi @70’
*FR / (G) FS / (G) OG	14.1-14.350 / 10.3dBi / 15.9dBi @70’
*FR / (G) FS / (G) OG	14.1-14.225 / 10.6dBi / 16.0dBi @70’
*FR / (G) FS / (G) OG	14.0-14.300 / 10.2dBi / 15.8dBi @70’
Front to back	24 dB Typical
Beamwidth	E=50° / H=64°
Feed type	Hair pin match
Feed Impedance	50 Ohms Unbalanced
Maximum VSWR	1:2.1

Input Connector	SO-239, Others avl.
Power Handling	3 kW, Higher avl.
Boom Length / Dia	44’ / 3” x .125 Wall
Element Length / Dia.	36.5’ / 1-1/2” To 1/2”
Turning Radius:	32’
Stacking Distance	48’ To 62’
Mast Size	2” to 3” Nom.
Wind area / Survival	12 Sq. Ft. / 125 MPH
Weight / Ship Wt.	135 Lbs. / 161 Lbs.

***Subtract 2.14 from dBi for dBd / FR = Frequency Range / G = Gain / FS = Free Space / OG = Over Ground**

FEATURES:

The 20M5-125 is the perfect balance between wind area and performance. It features improved gain and F/B across the 20 meter band. The 20M5-125 mph is computer optimized mechanically for maximum strength for it’s wind area. ***Mother nature will hate this one!*** Two different optimization options allow the antenna to be customized for your bandwidth and performance preferences, Plots with gain and F/B figures are supplied. Physically, the 20M5-125 Yagi features tapered elements, each element is secured with a pair of machined, 1/2” thick aluminum boom-to-element clamp plates. The clamps also permit spacing adjustments on the 3” x .125” wall boom. Elements taper in size from 1-1/2” to the adjustable 1/2” tips and are single and double sleeved at critical points to achieve a 125 MPH wind survival rating. All

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Rev.02

20M5-125 ASSEMBLY MANUAL

M^2's 20M5-125: The inside story
(Customizing for maximum advantage)

The design concept behind the 20M5 and the 20M5125 is to allow you to CUSTOMIZE the antenna to your needs and location. The latest computer techniques have been employed to produce the attached set of patterns and associated element spacing and lengths. The program used allows optimization of the Yagi not only for specific bandwidths, gain and F/B, but also for any height above ground and stacked pairs.

Look over the optimization choices carefully and make a note of the one that best suits your needs. The assembly manual that follows has element tip and spacing settings for your choice. We are sure that you will end up with an exceptional antenna and you will also learn more about Yagis in the process.

The computer program used to generate the plots and optimize the Yagi is YO (Yagi Optimizer) created by Brian Beezley, K6STI. The figures generated by the program have been checked against NEC and generally are within a few hundredths of a dB.

You may be accustomed to seeing inflated numbers on spec sheets and in advertising. Don't worry, the inflated numbers may be referenced to Isotropic (dBi), which is 2.14 dB higher than a dipole reference (dBd), or including as much as 6 dB of 'GROUND GAIN'. Other possibilities include errors or "marketing" guys that simply decided that a higher number would sell more antennas.

Actual realized gain, in the case of plots over perfect ground, may be somewhat less than the figures indicates. Most of us don't have perfect ground. Not only does the quality of the ground itself affect the actual number but, in most cases, the things above the ground. Houses, buildings and heavy trees all eat up the part of your pattern needed to generate ground gain.

To put this in perspective take the case of a station using a 5 dBd tribander up 70 feet located in open farmland of normal ground. The net gain at 13 degrees radiation angle is probably 10 dB. Compare that station to the 8.6 dBd monobander at 70 feet in the middle of a housing tract with perhaps only 2 dB of additional ground gain for a net of 10.6 dB. In a pile-up it would be a flip of a coin who would get through first. However, reverse the situation and the monobander would be ahead by miles.

Understanding this fact of life may not ease your frustration, but at least you can understand why some small stations do quite well and why some big stations are almost unbeatable. The flexibility of the 20M5 design at least allows you the get the most you can out of your QTH.

STACKING ANTENNAS for more gain can be most beneficial, however, some designs don't stack very well. Pattern and gain don't come up to expectations. The YO program allows us to optimize the gain and pattern for a stacked pair of 20M5125s. With the availability of rotating rings and rotating tower sections, more and more Amateurs will be taking advantage of the benefits of stacking. Think about it. The increased vertical capture area reduces fading and the compressed H plane pattern increases the efficiency of the signal as it reflects off the ground and ionosphere because the energy is reflecting off these mediums at a more grazing angle. While many computer programs don’t indicate a reduced angle of radiation for stacked Yagis, our results over the years indicate a greatly reduced radiation angle for stacked arrays.

20M5-125 ASSEMBLY MANUAL

NOTE: THE “DIMENSION SHEET” AND THE “HARDWARE ARRANGEMENT” DRAWINGS ARE QUITE COMPLETE WITH ASSEMBLY INFORMATION. EXPERIENCED BUILDERS MAY NOT REQUIRE THE WRITTEN INSTRUCTIONS. WHEN IN DOUBT, USE THE WRITTEN WORD. ANTI-SEIZE PASTE (PENETROX OR NOALOX) IS RECOMMENDED ON ALL HARDWARE THREADS AND ALUMINUM JOINTS. TOOLS REQUIRED: Electric drill, screw driver, 11/32" spintite or socket, 7/16" end wrench, 7/16", 1/2", and 9/16" socket set, measuring tape.

1. Determine which CUSTOMIZATION OPTION you prefer by looking over the Specification page and Plot printouts. USE THIS CHOICE TO SELECT THE CORRECT TIP LENGTHS, ELEMENT SPACING, AND MATCH SETTING AS YOU COMPLETE THE ANTENNA ASSEMBLY. For ease of assembly and for future reference, space has been provided on the Dimension Sheet to record all the critical measurements for the optimization option you select.

2. Pair up 1/2” element tip sections by length. Insert 1/2” sections into the swaged end of the 3/4” x 53” sections secure with 5/8” Compression Clamps (SEE COMPRESSION CLAMP & TIP ASSEMBLY DETAIL). Set the proper exposed tip length according to the table below. DIMENSIONS GIVEN ARE FOR 1/2” LENGTHS EXPOSED BEYOND THE 3/4” ENDS.

	CW-LO FONE	FULL BAND
REFL	51.625”	51.625”
D.E.	37.00”	35.25”
D1	36.00”	34.25”
D2	31.50”	30.75”
D3	25.875”	24.00”

Install all tip sections. Use a felt pen and masking tape to identify each element set by position as it is completed.

3. Slide a 7/8” X 23” EXTERNAL SLEEVE over the butt end of a 3/4" x 53” / 1/2” tip assembly and align holes. Install this assembly into the end of a 1" x 48” element section with holes at 1/2” and 1-1/2” from end. Use 8-32 x 1-1/4" screws and locknuts at the joint. Tighten securely. Slide a 7/8” x 32” SLEEVE SECTION into the butt end of the 1” section and align holes. Attach a 1-1/4” x 48” ELEMENT SECTION to 1” ELEMENT SECTION using 8-32 x 1-1/2” screws and locknuts. Repeat for all elements.

4. PARASITIC ELEMENT ASSEMBLY: Slide a 1-1/2” x 30” INNER ELEMENT SECTION onto each end of a 1-3/8” x 52” CENTER SLEEVE, align holes, and secure with a 1/4-20 x 2” bolt and locknut. Slide on the second 1-1/2 x 30” section. Align the holes and secure with the second 1/4-20 x 2” bolt and locknut. Place a clamp plate one either side at the center of this element assembly and rotate so the bolt heads are up. Add the 1/4-20 x 2-3/4” bolts trough the 6 holes and add the locknuts. Check the element centering again and then tighten the clamp block bolts evenly to keep the plates parallel. Repeat for the other two PARASITIC ELEMENTS.

5. DRIVEN ELEMENT ASSEMBLY: Refer to the HARDWARE ARRANGEMENT drawing and assemble THE LAST pair of ELEMENT CLAMP PLATES including the “L” BRACKET for mounting the balun. Slide in the 1-1/4” x 24” fiberglass rod, center it, align holes up and down and tighten the clamp bolts evenly. Now add the white poly rings to each side of the fiberglass rod and push them up against the clamp plates. Insert the 1-/38” x 26” sleeves into the last two 1-1/2 x 30” SOE tubes. Align the holes and carefully slide these assemblies over the fiberglass rod ends. Align all the holes and, FROM THE BOTTOM, insert two 1/4-20 x 2-1/2” bolts. Drop on two HAIRPIN CLAMP BLOCKS and add a locknut finger tight to each bolt.

20M5-125 ASSEMBLY MANUAL

6. BOOM ASSEMBLY: Inspect the CENTER BOOM SPLICE for any nicks or scratches. File smooth if any found. Locate Boom Section (3" X 0.125" X 180") swaged (1) end & Boom Section (3" X 0.125 X 180") straight. Before joining boom pieces together, lightly oil or lubricate the COUPLING RINGS & insert Boom Stiffener assembly into straight boom section. Insert Boom Stiffener assembly approximately 17" from the end. Make note: This is end must be positioned to the rear of the completed boom. This will center boom stiffener over the boom to mast plate (see dimension sheet). Add final Boom Section (3" X 0.125" X 180") swaged (1) end to complete boom. Secure all boom sections using 1/4-20 x 3-1/2 bolts and locknuts.

7. Orient the eyebolt eyes to the top of the boom. Place the boom on bucks or equivalent to get it to a convenient working height. Position one PARASITIC CENTER SECTION one inch from the end of the boom, add the saddle clamps and the four 1/4-20 x 3" bolts (a dab of Noalox on the threads make insertion easy). Align the top of the clamp to the eyebolt and tighten the saddle clamps evenly. Next, refer to the DIMENSION SHEET and using a tape measure and a marking pen or piece of tape, mark the ELEMENT LOCATIONS on the boom. Your choices are:

	CW-LO FONE	FULL BAND
REFL	0"	0"
D.E.	54.50"	61.000"
D1	116.00"	127.00
D2	323.00"	325.00"
D3	528.00"	528.00"

Dimensions represent the edge of the rear clamp block for each element. Now mount the center element assemblies on the boom the same as the reflector. Align each with the reflector and tighten.

8. HAIRPIN MATCH ASSEMBLY: Refer to the HARDWARE ARRANGEMENT drawing. Insert a 1/4-20 X 2-1/4" bolt from inside the band clamp and Install the band clamp loosely positioned about 30" inches in front of the driven element. Mount the BALUN using the 2-1/2" U-bolt and cradle but do not over tighten. Remove the finger tight nuts over the hairpin clamp blocks and place the balun lead lugs over the studs and replace the nuts finger tight. Next, slide the short bent end of the 3/8" tubes into the small hairpin clamp blocks and flush the ends of the tubes with the blocks. Align and tighten the clamp block bolts lightly. Install the shorting bar on the straight ends of the tubes and add the 1/4-20 x 1/4" set screws, but do not tighten on to the tubes yet. Set to the proper shorting bar dimension, align and tighten the set screws securely. Move the band clamp under the shorting bar, add the 3/8" spacer tube on the stud and drop the shorting bar over the stud and add the locknut. Tighten the band clamp, and then tighten the nut.. The dimension for your selected band coverage is:

CW LO FONE	FULL BAND
28.00"	31.500"

Refer to the DIMENSION SHEET. This dimension is from the inner edge of the shorting bar to the inner edge of the tube. Install the main feedline or feed line jumper on the 1:1 balun. Tape the connector up carefully. Use the large cable ties to secure the cable to the boom.

9. INSTALLING THE ELEMENT TIP SECTIONS: Start with the REFLECTOR tip sections and insert each double wall 1" element butt into the 1-1/4" center sections. align the holes and insert the 8-32 x 1-1/2" screws. Add the locknuts and tighten securely. Continue adding the other tip sections until the antenna is complete.

10. Determine the BALANCE POINT of the assembled antenna and mount the BOOM TO MAST PLATE using two 3 inch U-bolts, stainless steel lockwashers and nuts.

11. OVERHEAD BOOM SUPPORT SYSTEM.
A. Attach one end of the Dacron cord to the rear eyebolt using two turns around the eyebolt and a series of three half hitches or equivalent knots. Without cutting the cord, secure other end at the front eyebolt. Pull on the knots *HARD* to *SET* them and tape the excess cord back to main cord tightly with black vinyl electricians tape. Seal ends with heat or flame to prevent fraying.

B. TEMPORARILY insert a standard 2" U-bolt through the turnbuckle plate and add two nuts so about 1/2 inch of the threads stick out. Insert U-bolt studs through the top set of 2" U-bolt holes in the boom to mast plate from the boom side and add two more nuts. Open the two turnbuckles up until just a thread or two from each end shows inside the body of the turnbuckle. Hook the turnbuckles into the holes at the edge of the turnbuckle plate. Equalize the Dacron cord over the plate and cut it. Take two wraps of the cord through the eye of the rear turnbuckle, PULL the cord as tight as possible and make the knots as before. Repeat for the front cord section and turnbuckle. Cut off any excess over one foot long and again seal and tape the excess cord back to the main cord.

C. Now DISASSEMBLE the U-bolt from the boom to mast plate. The guy assembly is now centered and the turnbuckle plate ready to be installed to the mast and raised until the boom is straight.

If practical, after the final assembly and ***before*** installation, let the overhead guy system support the boom and take a set overnight: Install a 2' to 3' temporary 2" mast section to the boom to mast plate and attach and raise the turnbuckle plate. Support the antenna at the boom to mast plate. The Dacron cord DOES NOT STRETCH UNDER LOAD but cord and knots will take a SET and the boom may droop just a bit. Reset turnbuckle plate. If your boom droops again following this adjustment, check your knots - they may be may be slipping. If an overnight set is not possible, then after installing antenna on mast, lean on or pull on the cords to increase the tension and help the knots take their final "set." Make sure the knots are not slipping. When the guy system has taken a "set", loosen the 2" U-bolt and adjust turnbuckle plate height until boom is straight and level.

After final installation, do any minor boom straightening with the turnbuckles. Then safety wire to prevent changes to settings.

12. THIS COMPLETES THE ASSEMBLY. When the antenna is installed in position on the mast, the main feedline can be attached and sealed at that time. REMEMBER to support the feedline at the antenna boom and on the mast. Leave an adequate feedline loop for rotation around the tower. Mount horizontally polarized VHF and UHF antennas at least 40" above or below this antenna to minimize interaction.

CAREFULLY DESIGNED AND MANUFACTURED BY:

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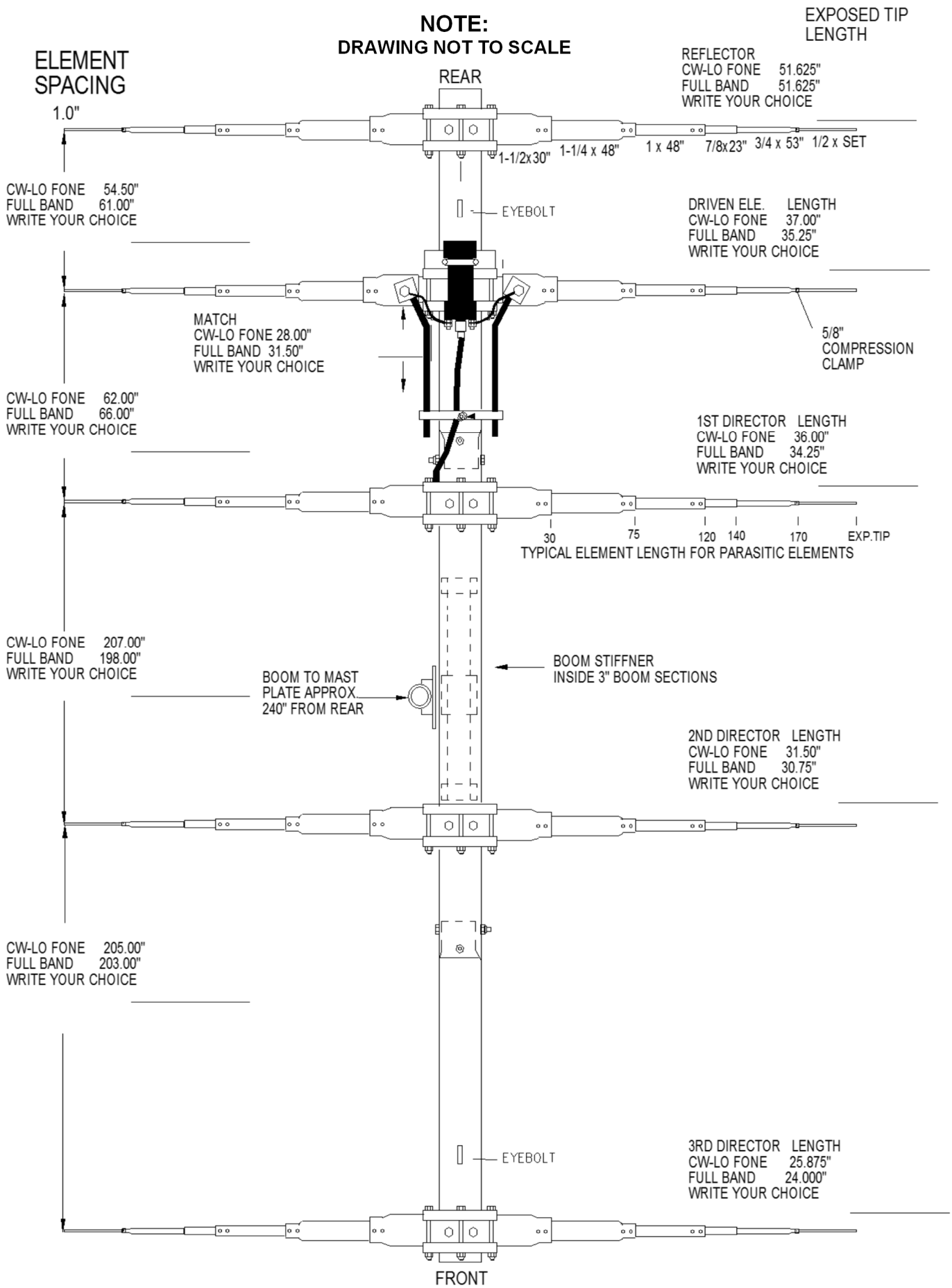
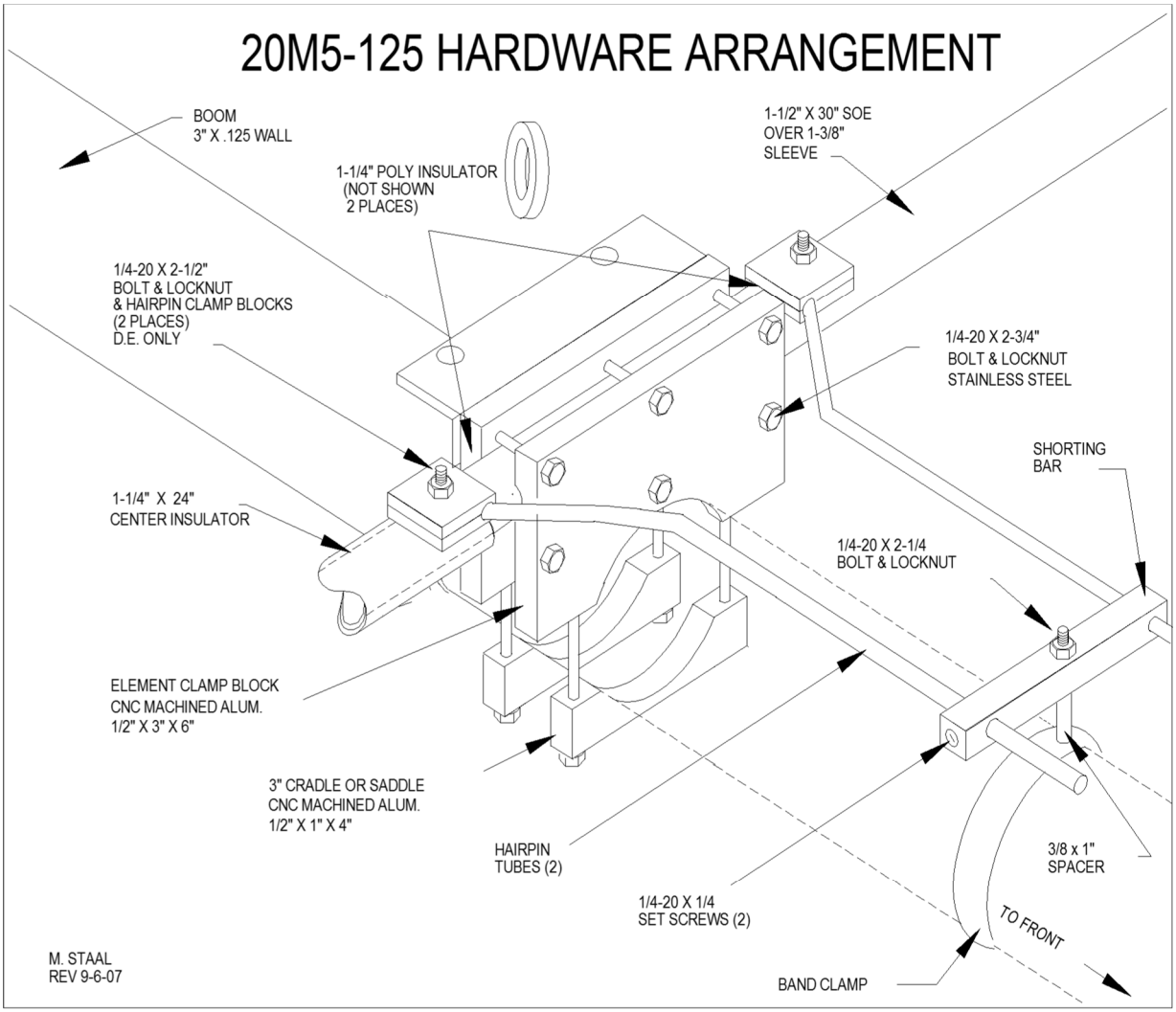
20M5-125 DIMENSION SHEET

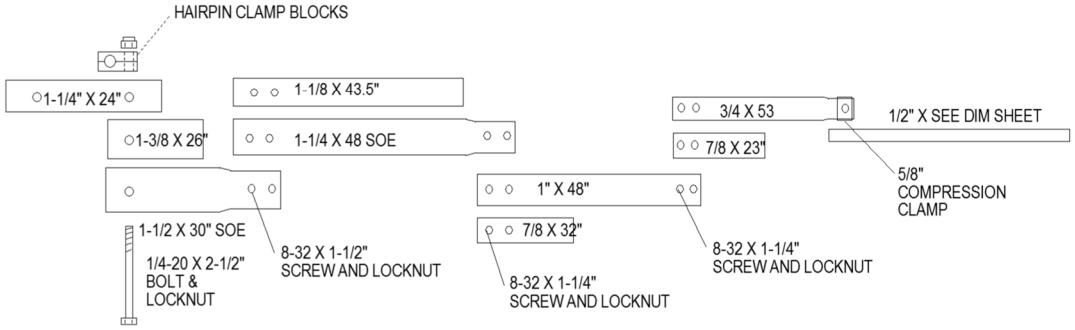


20M5-125 ASSEMBLY DETAILS

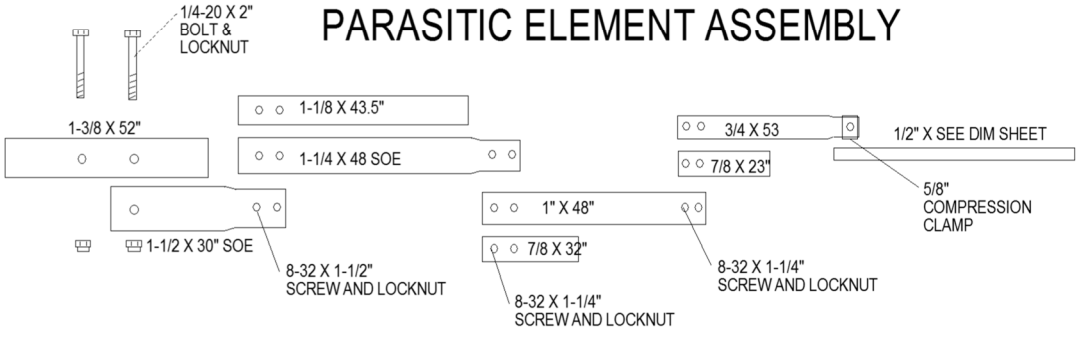
20M5-125 HARDWARE ARRANGEMENT



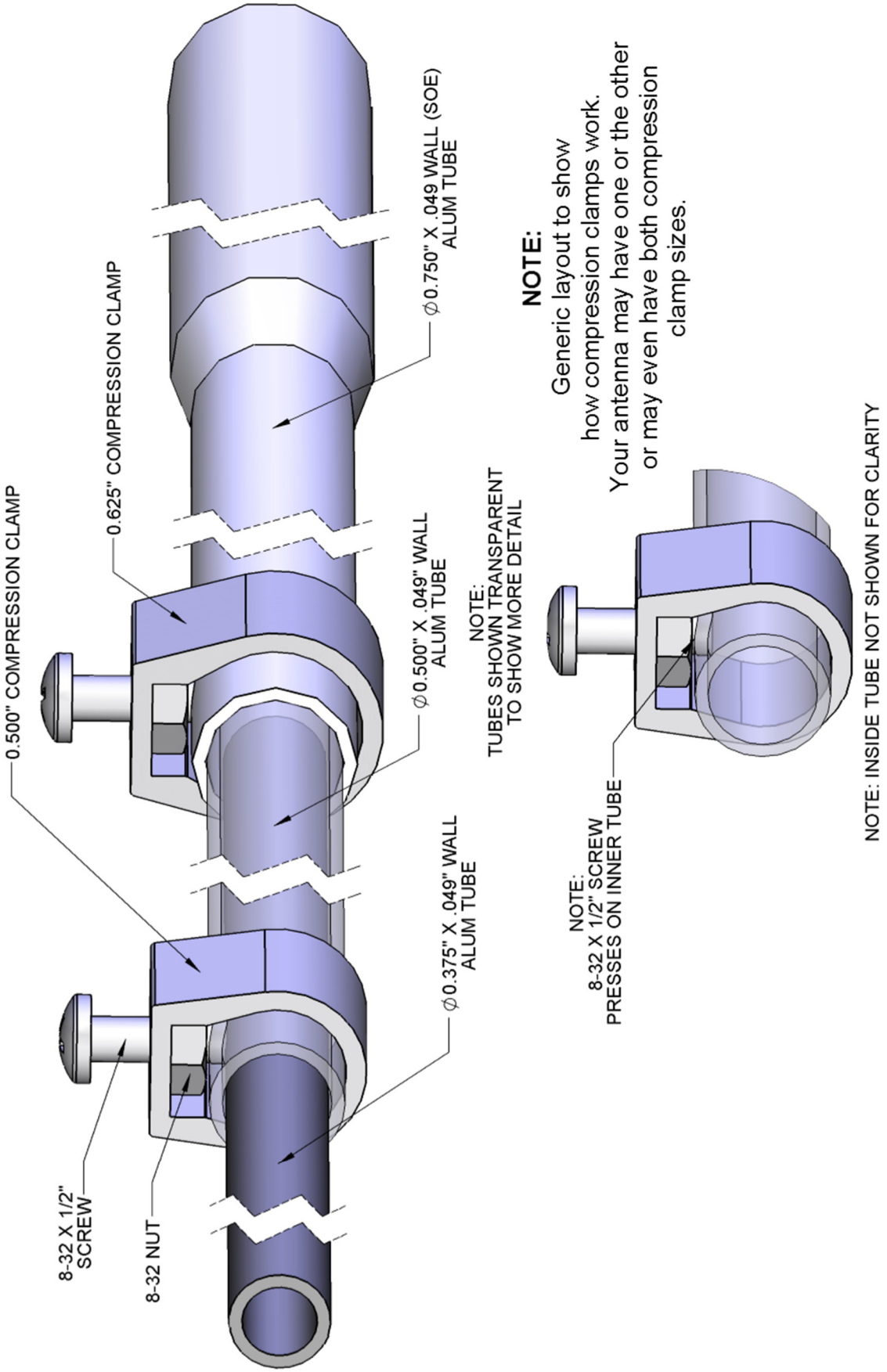
DRIVEN ELEMENT ASSEMBLY



PARASITIC ELEMENT ASSEMBLY



GENERIC COMPRESSION CLAMP DETAIL



20M5-125 PARTS & HARDWARE

DESCRIPTION	QTY
Boom sections, 3" x .125 x 15' swaged	2
Boom section, 3” x .125 x 15’ straight	1
Boom sleeve, 2-1/2 x 96"	1
Boom to mast plate, 8 x 8 x .250" (M2APT0070)	1
Element, 1-1/2 x .058 x 30" alum. tube SOE	10
Center Sleeve, 1-3/8” x .058 x 52” alum tube STR	4
Center Sleeve, 1-3/8” x .058 x 26” alum tube STR	2
Insulator, center 1-1/4” x 24” fiberglass (M2AFG0034)	1
Element, 1 -1/4 x .058 x 48" alum. tube SOE	10
Sleeve, 1-1/8 x .058 x 43.5” alum tube STR	10
Element, 1 x .058 x 48" alum. tube STR	10
Sleeve, 7/8 x .058 x 32” alum. tube STR	10
Element, 7/8 x .058 x 23” alum tube STR	10
Element, 3/4 x .049 x 53” alum tube SOE	10
Element tip, 1/2 x .049 alum. tube STR:(SEE DIMS.)	10
Hair pin tubes 3/8” x 40”, bent	2
Balun, 1:1 COAXIAL	1
Element Clamp Plate, 3 X 6 X 1/2" (M2AEC0041)	10
Machined Cradle, 3” LD, 1” x 4” x 1/2" (M2AMC0136)	10
Turnbuckle plate, 2 x 5 x 3/16" (M2APT0110)	1
Dacron rope, black 5/16 x 36 ft.	1
Turnbuckle, forged 3/8"	2
Eyebolt, forged 3/8 x 6"	2
Band clamp 2-1/2 to 3-1/2 ss	1
Poly disc, 1-1/4” (M2ADI0020)	2
Cable ties, large	3
U-bolt & Cradle, 3"	2
U-bolt & Cradle 2-1/2	1
U-bolt & Cradle 2" HD	4
U-bolt & Cradle 2"	1
Compression Clamp, 5/8” (M2AMC0145)	10
Assembly Manual	1
HAIRPIN PARTS BAG	
Hair pin shorting bar 1/2 X 1/2 X 5.0 (M2ASB0262)	1
Hair pin spacer 3/8 X 1.0 tube	1
Hair pin clamp plate	4
Balun “L” bracket 1 x 1 x .125 (M2APT0016)	1
IN HARDWARE BAG	
Bolt, 1/4-20 x 3-1/2” ss	4
Bolt, 1/4-20 x 3" ss	20
Bolt, 1/4-20 x 2-3/4" ss	30
Bolt, 1/4-20 x 2 ss	8
Bolt, 1/4-20 x 2-1/2” ss	2
Bolt, 1/4-20 x 2-1/4 ss	1
Set screw, 1/4-20 x 1/4 ss	2
Nut, 1/4-20 locking, ss	43
Nut, 5/16-18 ss	4
Lockwasher, 5/16 ss	4
Nut, 3/8-16 ss	14
Lockwasher, 3/8 split ring ss	14
Screw, 8-32 x 1-3/4" ss	20
Screw, 8-32 x 1-1/2" ss	20
Screw, 8-32 x 1-1/4" ss	20
Screw, 8-32 x 1/2" ss	10
Nut, 8-32 locking, ss	60
Nut, 8-32, ss	10
Allen wrench 1/8	1
Penetrox cup	1

20M5-125 ANTENNA PLOTS

CW-LO FONE PLOTS FULL BAND PLOTS