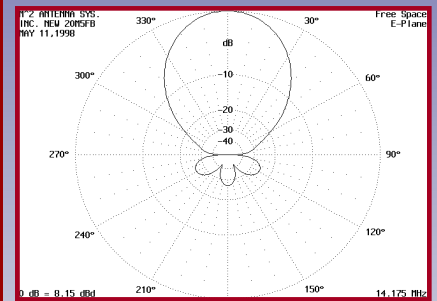
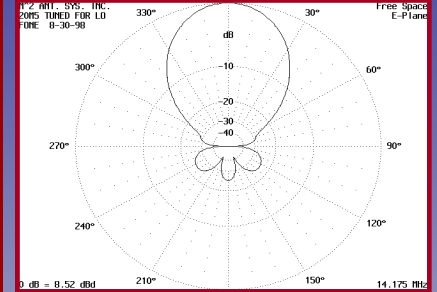
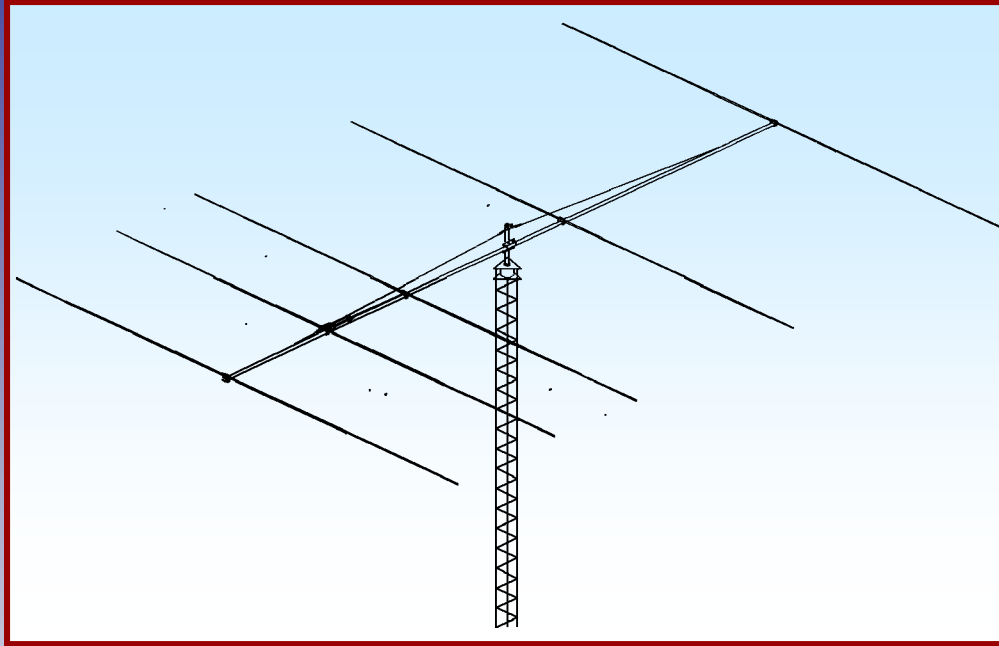




# M2 Antenna Systems, Inc.

## Model No: 20M5



### SPECIFICATIONS:

Model .....	20M5
*FR / (G) FS / (G) OG .....	14.0-14.350 / 10.2dBi / 15.8dBi @70'
*FR / (G) FS / (G) OG .....	14.1-14.350 / 10.4dBi / 15.9dBi @70'
*FR / (G) FS / (G) OG .....	14.1-14.250 / 10.5dBi / 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, Other avl.
Power Handling .....	3 kW, Higher avl.
Boom Length / Dia .....	44' / 3"
Element Length / Dia .....	36.5' / 1-1/4" To 1/2"
Turning Radius .....	32'
Stacking Distance .....	48' To 62'
Mast Size .....	2" to 3" Nom.
Wind area / Survival .....	10.5 Sq. Ft. / 100 MPH
Weight / Ship Wt. ....	105 Lbs. / 134 Lbs.

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

### FEATURES:

The 20M5 is getting rave reviews! It is staying IN the air and ON the air while others are coming apart. The best part is that it is the way it make contacts enjoyable. The 20M5 has a clean pattern and great gain over the band as a result of careful computer optimization and construction. If you like you can customize it to your favorite part of the band and performance preferences. Stacked with a mate at 62 feet apart a full 3 dB improvement can be realized. Most other designs won't give you that advantage.

Physically, the 20M5 has been carefully engineered to maximize strength and durability while keeping weight and wind area under control. A pair of machined, 1/2" thick aluminum boom-to-element plates and saddles ground each element and make spacing adjustments easy along the 3" x .125" wall boom. Elements taper in 1/4" steps from 1-1/4" to the adjustable 1/2" tips. A sturdy Hairpin match grounds the driven element and makes matching easy. All critical hardware is stainless steel. The 20M5 is sold factory direct to discriminating Hams. For over 100 mph locations, ask us about our **SURVIVOR SERIES!**

# 20M5 ASSEMBLY MANUAL

## M<sup>2</sup>'s 20M5: The inside story (Customizing for maximum advantage)

The design concept behind the 20M5 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 spacings 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 learn more about Yagis in the process.

The computer program used to generate the plots and optimize the Yagi is YO7.53PRO (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 figure 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 14 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 to 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 YO7.58PRO program allows us to optimize the gain and pattern for a stacked pair of 20M5's. 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 ionosphere. While many computer programs don't indicate the reduced angle of radiation, our results over the years indicate a greatly reduced radiation angle for stacked arrays. The gain figure in the STACKED plot provided here is in free space.

**NOTE:** WE PROVIDE A GREAT DEAL OF ASSEMBLY INFORMATION ON THE DIMENSION SHEET. EXPERIENCED PERSONS MAY ONLY NEED THE WRITTEN INSTRUCTION FOR SPECIAL AREAS OR FOR ORDER OF ASSEMBLY.

**TOOLS REQUIRED:** Electric drill, screw driver, 11/32" spinet or socket, 7/16" end wrench, 7/16", 1/2", and 9/16" socket set, measuring tape. We recommend the use of zinc paste (Penetrox or Noalox) at each joint in the antenna.

# 20M5 ASSEMBY MANUAL

1. Determine which set of dimensions from the DIMENSION SHEET best suits your needs. 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. Insert 1/2" sections into the swaged end of the 3/4" sections and set the proper exposed tip length according to the table below. Secure with 5/8" Compression clamps (SEE COMPRESSION CLAMP AND TIP ASSEMBLY DETAIL SHEET). DIMENSIONS GIVEN ARE FOR 1/2" LENGTHS EXPOSED BEYOND THE 3/4" TIPS.

	CW-LF	LO FONE	FULL FONE	FULL BAND	
REFL	66.625	65.50	65.625	70.125	(1/2 x 73.0" stock)
D.E.	53.625	52.50	50.75	54.25	(1/2 x 58.0" stock)
D1	52.375	53.00	51.00	54.25	(1/2 x 58.0" stock)
D2	48.875	48.50	48.50	51.625	(1/2 x 55.0" stock)
D3	43.125	45.50	43.75	45.25	(1/2 x 48.0" stock)

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

3. The 1"x 60" section may have a 7/8" x 35" sleeve inserted inside during manufacturing, if not add it at this time. Assemble the 1" x 60" element sections with sleeve to the 7/8" x 23" section. Use 8-32 x 1-1/4" screws and locknuts and tighten securely. Next, assemble the 3/4" tip assemblies to the 7/8" X 23" sections. Use 8-32 x 1-1/4" screws and locknuts and tighten securely.

4. Assemble 4 sets of ELEMENT CLAMP PLATE pairs using 1/4-20 x 2-1/2" bolts and locknuts, finger tight. Next, slide a 1-1/4" x 60" section into 4 CLAMP PLATE sets. Rotate each section so the tip holes will be vertical when the element is mounted on the boom. Center each section (27 inches sticking out each side) and tighten the clamp plate bolts evenly, so the sides of the two plates stay parallel. Repeat for all four parasitic element center sections.

5. DRIVEN ELEMENT. Assemble the last pair of element clamp plates but add the angle bracket for Balun mounting to the clamp plate assembly with the top of the bracket sticking out away from the clamp plate. Now, insert the 1" x 24 fiberglass rod into the 5th clamp set and center so that 9 inches sticks out each side. Rotate the rod so the bolt holes are vertical and tighten the clamp bolts. Slip on the POLY DISCS. Insert the 1-1/8" x 26" sleeves into the 1-1/4" x 30" sections and slide this assembly over the fiberglass rod, align the holes, and insert the 1/4-20 x 2-1/4" bolts up from the bottom. Add two 3/8 HAIRPIN CLAMP BLOCKS on each bolt and the locknuts; finger tight at this time.

6. Assemble the boom sections by inserting the two sections with swages into the center straight section. Add two 1/4-20 x 3-1/2" bolts, and locknuts to each joint and tighten. Install the two eyebolts in the boom end sections and tighten the nuts. If you are using the **optional** 96" boom stiffener, Slide it into the center straight section and center it at the balance point, prior to boom assembly.

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. 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. START from ONE INCH IN from the rear of the boom.

	CW-LF	LO FONE	FULL FONE	FULL BAND
REFL	0.0	0.0	0.0	0.0
D.E.	65.50	57.00	64.50	78.125
D1	60.375	63.00	75.50	72.875
D2	195.375	205.50	190.50	177.25
D3	206.75	202.50	197.50	199.75

Dimensions reference the center to center spacing between elements.

# 20M5 ASSEMBLY MANUAL

8. At the REFLECTOR element location, mount a center element assembly on the boom using a SADDLE CLAMP under each ELEMENT CLAMP PLATE (see Assembly Drawing). Secure with four 1/4-20 x 2-3/4" bolts. Align the element with the EYEBOLTS and tighten bolts.

9. Mount the DRIVEN ELEMENT center assembly with the balun bracket facing the reflector. Add the two saddles and secure with four more 1/4-20 x 2-3/4" bolts. Align and tighten gently. Continue mounting the three DIRECTOR center sections.

10. Next, attach the 1", 7/8", 3/4", and 1/2" tip assembly pairs to both ends of the 1-1/4" central element sections using 8-32 x 1-1/2" screws and locknuts. Double check for correct lengths and positions. Tighten securely.

11. HAIRPIN MATCH: insert a 1/4-20 x 2-1/2-1/4" bolt in through the band clamp and position the band clamp about 40 inches in front of the driven element. Slide the short bent end of the 3/8" tubes into the clamp blocks and flush the ends of the tubes with the blocks. Align and tighten the clamp block bolt 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 onto the tubes yet. Set to the proper shorting bar dimension. Slide the band clamp and stud up next to the shorting bar. Drop the 3/8 x 1" spacer tube on the stud and set the shorting bar over the stud. Align and tighten the set screws securely. Tighten the band clamp. Then add the 1/-20 locknut to the stud. The dimension for your selected band coverage is:

CW-LF	LO FONE	FULL FONE	FULL BAND
39.25"	25.0"	26.0"	31.0"

This dimension is from the inner edge of the shorting bar to the INNER surface of the element. Install the 1:1 balun with a 2-1/2" U-bolt and cradle. Do not over tighten the U-bolt as damage can occur to the balun housing. Route the balun leads to the top of the clamp blocks. Remove the nuts, place the balun lead wire terminals over the studs, reinstall the nuts and tighten the assembly. Install the main feed line or feed line jumper cable and tape the connector up carefully. Use the large cable ties to secure the cable to the boom.

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

## 13. OVERHEAD BOOM SUPPORT SYSTEM.

A. Attach one end of the 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 that 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.

# 20M5L ASSEMBLY MANUAL

D. 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 slipping. If an overnight set is not possible, then after installing antenna on mast, lean 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.

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

14. This completes the ASSEMBLY. Before 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:

**M<sup>2</sup> ANTENNA SYSTEMS, INC.**

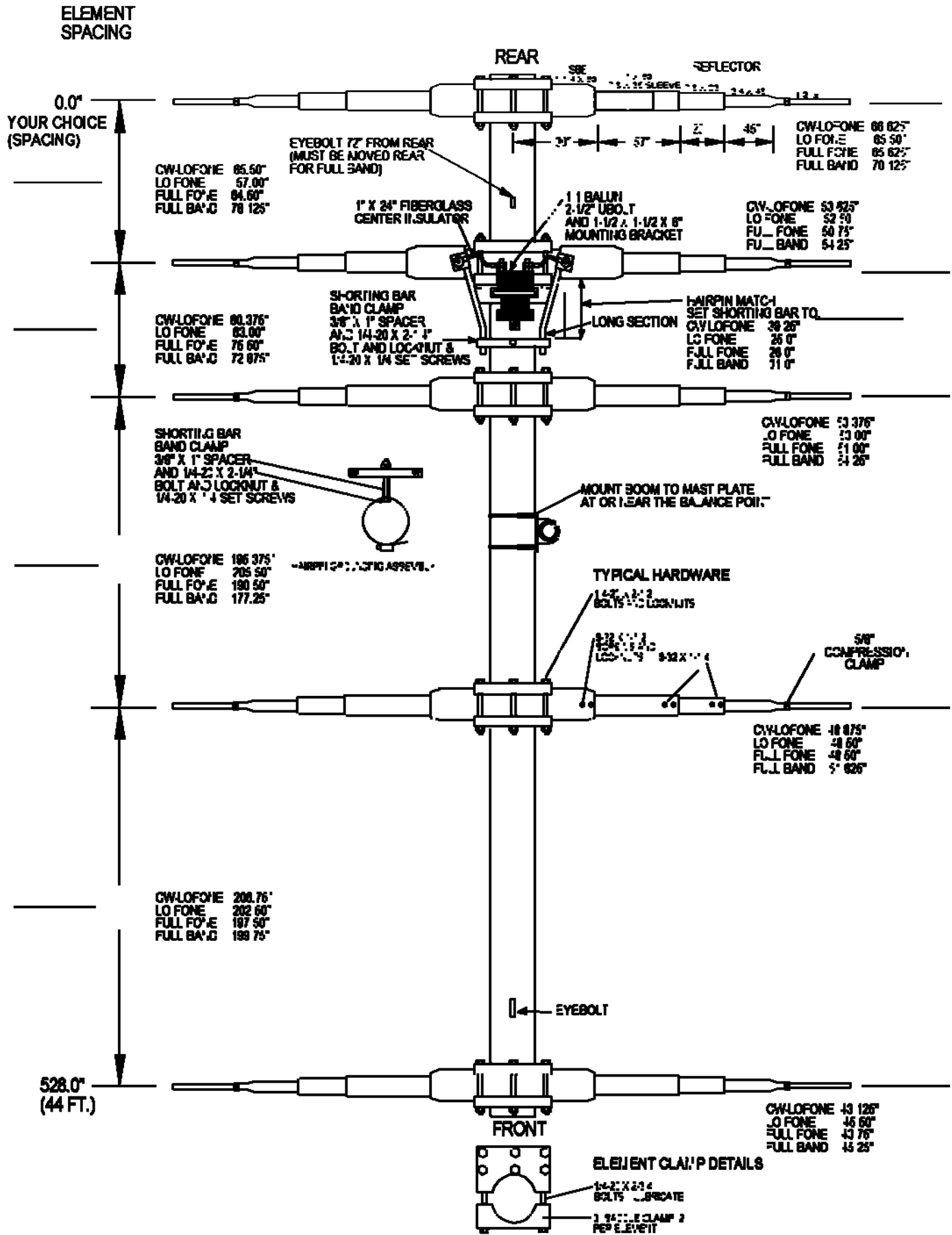
4402 N. SELLAND AVE.

FRESNO, CA 93722

(559) 432-8873 FAX: 432-3059

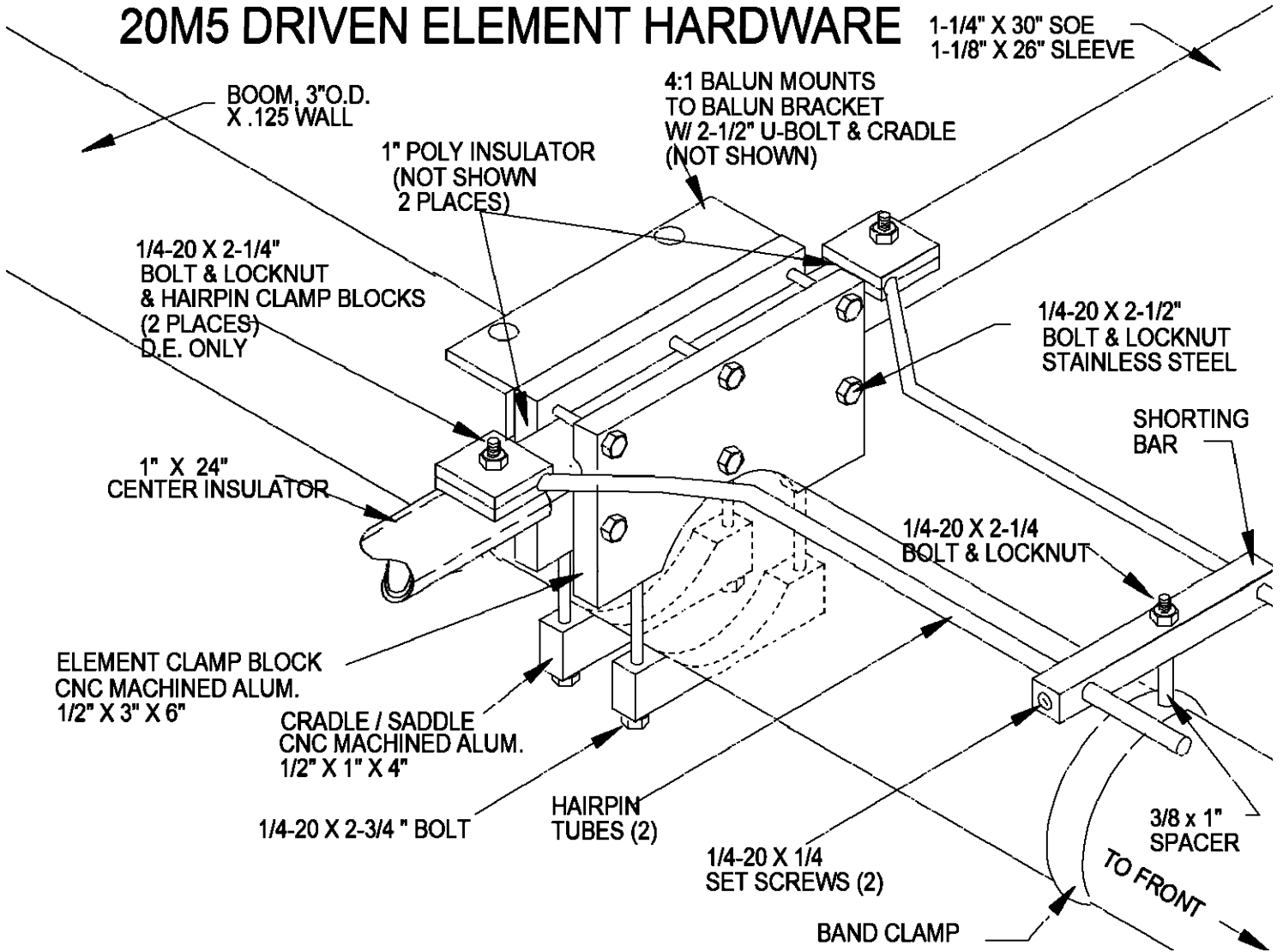
[www.m2inc.com](http://www.m2inc.com) Email: [sales@m2inc.com](mailto:sales@m2inc.com)

# 20M5 DIMENSION SHEET

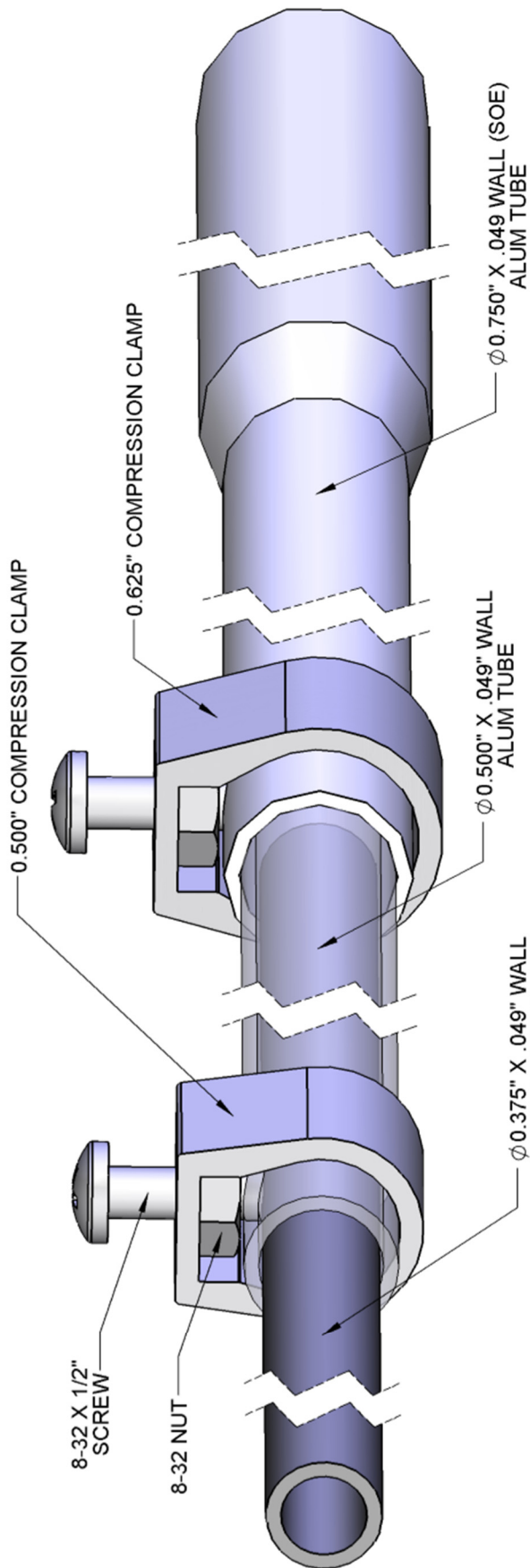


# 20M5 ASSEMBLY DETAIL

## 20M5 DRIVEN ELEMENT HARDWARE

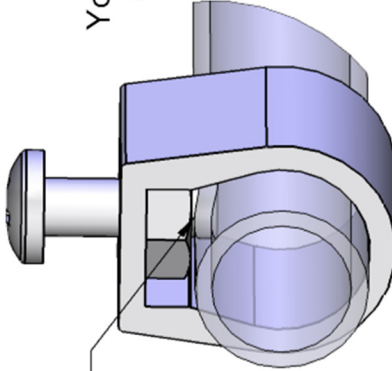


# GENERIC COMPRESSION CLAMP DETAIL



NOTE:  
TUBES SHOWN TRANSPARENT  
TO SHOW MORE DETAIL

**NOTE:**  
Generic layout to show  
how compression clamps work.  
Your antenna may have one or the other  
or may even have both compression  
clamp sizes.



NOTE:  
8-32 X 1/2" SCREW  
PRESSES ON INNER TUBE

NOTE: INSIDE TUBE NOT SHOWN FOR CLARITY



# 20M5 PARTS & HARDWARE

DESCRIPTION	QTY.
BOOM SECTIONS, 3" X .125 X 15' SWAGED .....	2
BOOM SECTION, 3" X .125 X 15' STRAIGHT .....	1
BOOM TO MAST PLATE, 8 X 8 X .250" .....	1
ELEMENT 1-1/4 X .058 X 60" ALUM. TUBE SBE W/SLEEVE .....	4
SLEEVE, 1-1/8" X 52" ALUM. TUBE ,SHIPPED INSIDE 1-1/4 .....	4
ELEMENT DRIVEN, 1-1/4 X .058 X 30" ALUM. TUBE SOE.....	2
SLEEVE, 1-1/8 X .058 X 26" ALUM. TUBE, FOR THE 1-1/4 X 30" .....	2
1 X .058 X 60" ALUM. TUBE.....	10
SLEEVE, 7/8 X .058 X 35",SHIPPED INSIDE 1" X 60" .....	10
7/8 X .058 X 23" ALUM. TUBE.....	10
3/4 X .049 X 48" ALUM. TUBE SOE .....	10
1/2 X .049 X SEE DIMENSION SHEET .....	10
DRIVEN ELEMENT HAIR PIN TUBES 42" .....	2
BALUN, 3-30 MHZ 1:1 STANDARD.....	1
ELEMENT CLAMP BLOCK, 3 X 6 X 1/2" #6 .....	10
SADDLE CLAMP 1 X 4 X 1/2" .....	10
TURNBUCKLE PLATE, 2 X 5 X 3/16".....	1
TURNBUCKLE, 3/8" .....	2
EYEBOLT, 3/8 X 6".....	2
DACRON ROPE, 5/16" X 36 FT.....	1
CABLE TIES, LARGE .....	3
U-BOLT, 3".....	2
U-BOLT, 2" HEAVY DUTY .....	4
U-BOLT, 2" STANDARD (FOR TURNBUCKLE).....	1
U BOLT, 2-1/2" ( FOR BALUN).....	1
COMPRESSION CLAMP, 5/8".....	10
FIBERGLASS INSULATOR, 1" X 24" STANDARD .....	1
ASSEMBLY MANUAL .....	1

## HAIRPIN PARTS BAG

HAIRPIN SHORTING BAR, 1/2 X 1/2" X 5.0.....	1
HAIRPIN SPACER, 3/8 X 1" TUBE .....	1
HAIRPIN CLAMP BLOCKS.....	4
L BRACKET, BALUN MTG 1 X 1 X 6" ALUM.....	1
POLY DISC INSULATOR 1" .....	2
SET SCREW, 1/4-20 X 1/4" SS .....	2
BAND CLAMP, MODIFIED, 2-1/2-3-1/2", SS #52 .....	1
NUT, LOCKING, 1/4-20 SS.....	3
BOLT, 1/4-20 X 2-1/4" SS .....	3

## IN HARDWARE BAG #1

BOLT, 1/4-20 X 3-1/2" SS .....	4
BOLT, 1/4-20 X 2-3/4" SS .....	20
BOLT, 1/4-20 X 2-1/2" SS .....	30
1/4-20 LOCKING, SS .....	34
NUT, 5/16-18 SS.....	4
LOCKWASHER, 5/16 SS.....	4
NUT, 3/8-16 SS.....	14
LOCKWASHER, 3/8 SPLIT RING SS .....	14

## IN HARDWARE BAG #2

SCREW, 8-32 X 1-1/2" SS .....	20
SCREW, 8-32 X 1-1/4" SS .....	40
SCREW, 8-32 X 1/2" SS .....	10
NUT, 8-32 LOCKING, SS.....	60
NUT, 8-32, SS.....	10
ALLEN WRENCH, 1/8" .....	1
ZINC PASTE, CUP .....	1

## M<sup>2</sup> ANTENNA SYSTEMS, INC.

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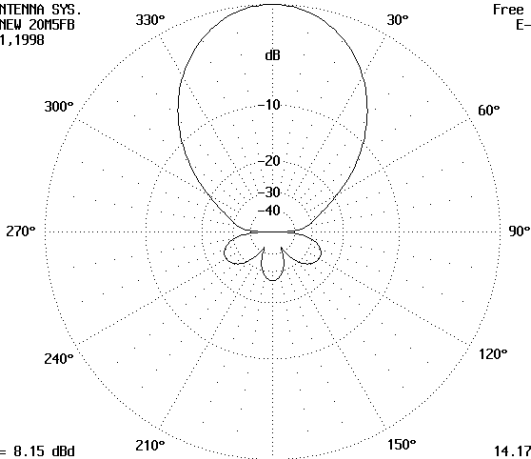
FRESNO, CA 93722

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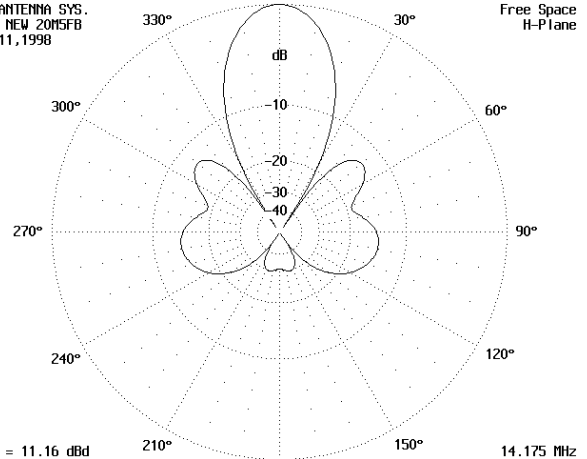
www.m2inc.com Email: sales@m2inc.com

# 20M5 ANTENNA PLOTS

M<sup>2</sup> ANTENNA SYS.  
INC. NEW 20M5FB  
MAY 11, 1998



M<sup>2</sup> ANTENNA SYS.  
INC. NEW 20M5FB  
MAY 11, 1998



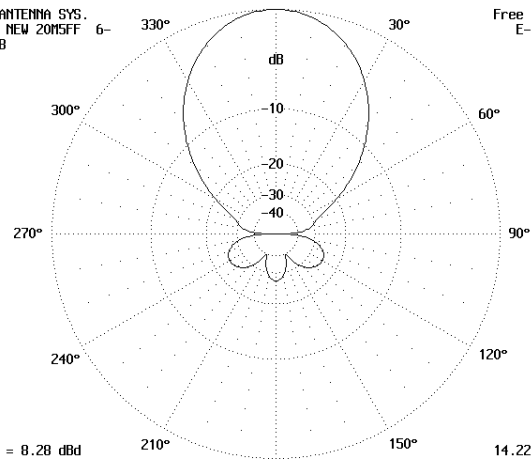
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14.175 MHz

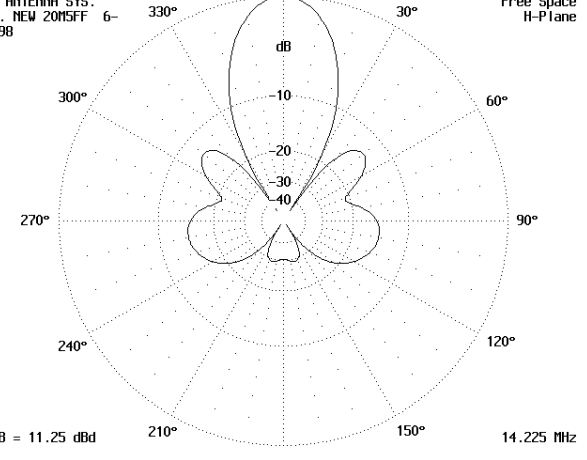
0 dB = 11.16 dBd

14.175 MHz

M<sup>2</sup> ANTENNA SYS.  
INC. NEW 20M5FF 6-  
19-98



M<sup>2</sup> ANTENNA SYS.  
INC. NEW 20M5FF 6-  
19-98



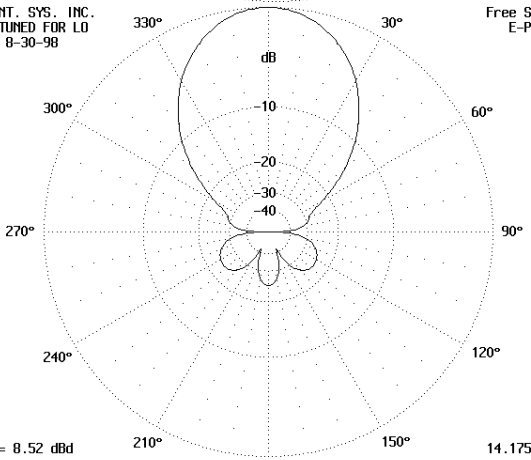
0 dB = 8.28 dBd

14.225 MHz

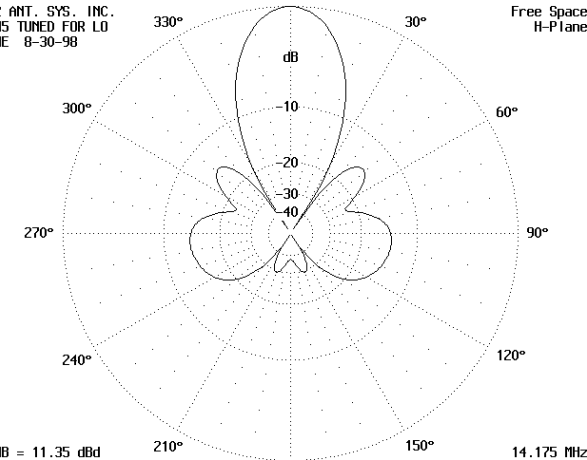
0 dB = 11.25 dBd

14.225 MHz

M<sup>2</sup> ANT. SYS. INC.  
20M5 TUNED FOR LO  
FONE 8-30-98



M<sup>2</sup> ANT. SYS. INC.  
20M5 TUNED FOR LO  
FONE 8-30-98



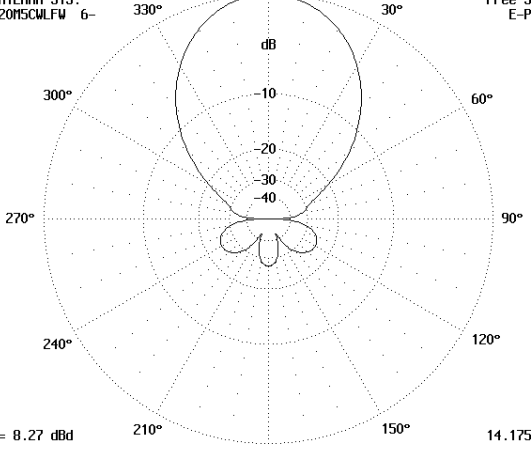
0 dB = 8.52 dBd

14.175 MHz

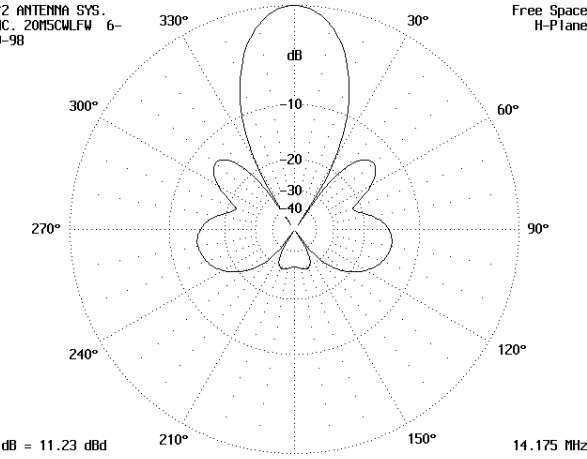
0 dB = 11.35 dBd

14.175 MHz

M<sup>2</sup> ANTENNA SYS.  
INC. 20M5CMLFW 6-  
19-98



M<sup>2</sup> ANTENNA SYS.  
INC. 20M5CMLFW 6-  
19-98



0 dB = 8.27 dBd

14.175 MHz

0 dB = 11.23 dBd

14.175 MHz