

10/15 M Dual Band Dual feed 26-foot Boom

5 elements on 10m 10.2 dBi 17 dB F/B 28-28.7 MHz
4 Elements on 15m 9.0 dBi 17 dB F/B 21-21.45 MHz

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Description:

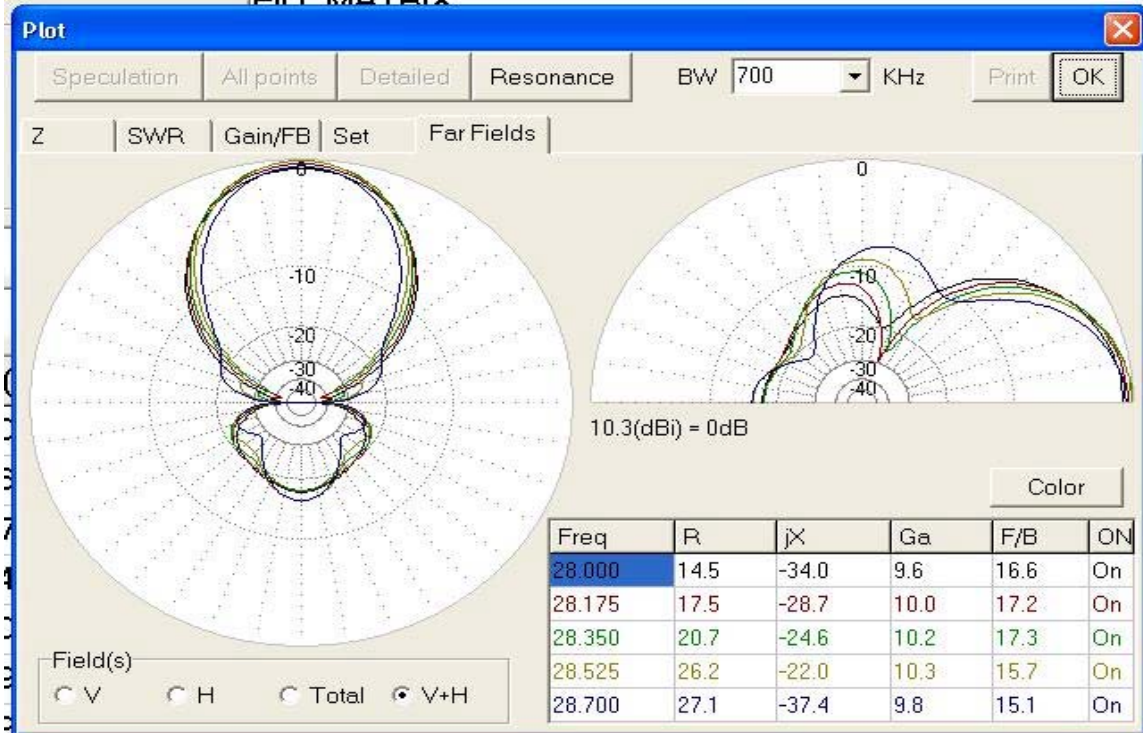
This is an interlaced 10 and 15m mono-band yagi on a 26 foot 2" boom with separate feeds for both bands. This design is a trade off between reasonable Gain and F/B while maintaining a VSWR of 2:1 or less across both bands. This antenna was design to solve a need at the K1IR contest station. K1IR did not have the available room for a 3 high christmas tree stack on mono-band antennas on his tower and did not want degraded performance associated with a short stack on yagi antennas typically installed on the top of a tower. The antenna described has been successfully used as the main 10/15M antenna at K1IR M/S station in all 4 major contests in the last year. K1IR has report excellent results using this dual-band solution. This design is built around DX engineering hardware to keep the machine fabrication to a minimum. No attempt has been made to balance the weight distribution of the yagi. It is recommended that a dummy PVC element be place towards the front of the boom to compensate.

Background,

In a closely spaced installation of 10 and 15m mono band yagi antenna, the typical separation distance is anywhere from 5 to 10 feet. The general rule of thumb is $\frac{1}{2}$ the boom length or 10% of the lowest frequency of the two closely spaced yagis. With the advent of NEC and Mininec variants available to model antennas, it becomes quite clear the 10m yagi will suffer greatly if placed within 15 feet of the 15 or 20m yagi. It is not uncommon to have a reduction in gain of 3 dB on 10m with this typical installation and yet see no ill effects in VSWR or F/B. While it is beyond the scope of this design article to go into great depths on the subject of closely spaced antenna, this design solves the interaction issue and is offered as a reasonable solution. Unfortunately, there are very few manufactures of these kinds of antennas so we are forced to design our own. .

The specs are as follows:

Freq	Gain (dBi)	F/B	Zin	Matched
28.0	9.6	16.6	14.5-j34	1.85:1
28.35	10.2	17.3	20-j25	1:1
28.7	9.8	15.1	27-j37	1.85:1
21.0	8.9	16.0	29-j33	1.4:1
21.22	9.0	17.2	30-j25	1:1
21.45	9.1	17.0	29-j15	1.4:1



Gain on 10M, note sidelobes on 10m due to phase errors from 15m elements,



Gain on 15M

Elements are made up as follows except for both driven elements which are split down the center.

	half element lengths		(exposed lengths)		*.5"dia can be .049WT
	0.875	0.75	0.625	0.5	
150.875	18	32	20	71.5	R15
-126		14	32	62.313	R10
-76.85		14	32	51.25	DE 10
-48.25	18	32	20	63	DE15
-22.875		14	32	53.75	D10-1
21.75	18	32	20	61.438	D15-1
68.875		14	32	53.188	D10-2
126	18	32	20	48.25	D15-2
150.875		14	32	52.625	D10-3

Not a typo

Use min 4" overlap

Directors and reflectors are mounted in DX – Engineering DXE-BEP-4 plates (3.5"x8"x.190"). Driven elements are cut in half and drilled to fit DX Engineering DXE-BEB-2 insulated element brackets. See DX Engineering web site for info www.dxengineering.com

A short length of 6" long .875"dia tubing should be slipped over the ends of the 10m director to fit the bracket and strengthen the joint. On the 15M DE, a 6" pc of .75" tubing should be inserted in to the open end of the 7/8 tube to strengthen the joint.

In all cases, the tubing overlap should be at least 4". The lengths above are the exposed lengths only. Use rivets, SS screws with nylock nuts, or SS hose clamps to lock the joints. The 1/2" dia tips of both DE should be attached with hose clamps for tuning and the overlap should be 8" to accommodate SWR adjustments. For long term reliability, some form of anti oxidize compound should be used at each joint.

Feed System:

The feed system used the DX Engineering beta match DXE-HMS-1P on each driven element. You may fabricate your own system. The beta matches should be positioned to cause least interference with the driven elements, toward REF works if you trim them. Preset the beta matches as detailed below. It is recommended that a coaxial choke be made for each DE. 6T of RG213 or Equiv on a 4 "dia form in solenoid style should be all that is required. Strip ends of cable and solder on lugs to attach to beta match. Seal coax and keep these pigtails as short as possible as they add to the driven element lengths.

Boom

Cut the 1.875" tube into 3 pc's 6", 32" and 108" long.

Mark the center of the 108" tube and insert into 1 end of the 2"X12' tube

Pin with 2 1/4"x20 SS bolts place bolts so they will not interfere w/ element clamps

Slide other 12' – 2"od over other end of 1.875" tube. Pin 2 places with 1/4X20 SS bolts.

Install 6" pc of 1.875" tube flush on one end of 24ft assy. Rivet in place, this is the reflector end.

Install 32' 1.875" tube in the other end of the 2" boom assy. Pin with 2-

10-24 -2.5" SS screws leaving 24" of the 1.875" tube exposed to make boom 26' long

Mark 4.5" in from 6" tube end and mark locations for all elements.

Elements

Build elements as marked leaving exposed lengths from chart for each section. It is recommended that elements are cut with a high quality tubing cutter not a hack saw. You can find a high quality tubing cutter at Home depot for about \$25. Don't use the handyman special but buy a quality tubing cutter.

The center tubes of both DE are cut in half. Install the 6" tubes (.625 for 15m and .875 for 10m) flush with the cut ends. Using a center punch, carefully dimple tubes 5" in from ends to lock in place. Don't worry the insulated DX Engineering element clamps and hardware kits will secure the elements. I suggest 3/4 to 1" air gap between the driven element tubes when mounting them in the clamps. On the DE, slot the 5/8" tube to allow adjustment of the 1/2" tube for VSWR. 3X rivets or 2 #8 SS screws and nylock nuts are suggested methods to join the tubing sections. You may want to slot all the 5/8" tubes for future adjustments and keep the other joints fixed. Mount the elements per the location chart. Do not over tighten. You may want to check the beam for balance before installing on the tower. A 1.5" sch 40 PVC pipe placed near the director end can be used to better balance the beam. See ARRL antenna handbook for details.

Tuning

The antenna is best tuned at minimum of 10 feet above the ground. A minor shift will occur after installation on the tower but not enough to warrant concern. Attach a balun/coax cable to the 15m DE. Adjust for best match in center of band. Check the band edges. VSWR should be less than 1.6 or 1.7 across the band. You may need to shorten the DE if you used a long pigtail on the coax to beta match connection. Next follow the same procedure for 10m. Matching will be more difficult. Expect a 1.9:1 or less across the 28-28.7 MHz band. The effects of the pigtail will be dramatic on this band. Set the beta match per the table and adjust the element tips to center the VSWR then adjust the beta match. The beta match rods are over 30" long

10m beta match dim 5.75" trim off excess so it will not touch other elements.

15m beta match dim 11.75" trim off excess so it will not touch other elements.

Boom truss and other hardware

See DX Engineering web site and documentation for details

Place each boom truss clamps in a convenient location about 2/3's the distance out from the boom center on each side.

BOM (DXE and Texas Tower for pricing)

All hardware is SS

Qty	Desc	Length (in)	Total feet	adjusted(12')	\$/ft	COST	NOTES	
5	.875"x.058WT	36	15.00		2	1.1	26.4	15m
10	.75"x.058WT	36	30.00		3	1	36	10m
10	.625"x.058WT	36	30.00		3	0.9	32.4	10m
2	.5"x.049WT	67	11.17		1	0.8	\$9.60	R10 DE-D3
8	.5"x.049WT	59	39.33		4	0.8	\$38.40	10
8	.75"x.058WT	18	12.00		1	1	\$12.00	15m
8	.625"x.058WT	24	16.00		2	0.9	\$21.60	15m
2	.5"x.049WT	76	12.67		2	0.8	\$19.20	R15
2	.5"x.049WT	70	11.67		1	0.8	\$9.60	DE15
2	.5"x.049WT	66	11.00		1	0.8	\$9.60	D1-15
2	.5"x.049WT	53	8.83	(left over from 76")			\$0.00	D2-15 10m
2	.875"x.058WT	6	1.00	left over			\$0.00	DE 15M
2	.625"x.058WT	6	1.00	left over			\$0.00	DE
2	2"x.058WT	144	24.00		2	3	\$72.00	
1	1.875"x.058WT	144	12.00		1	2.75	\$33.00	
7	DXE-BEP-4 (element plate)					11.55	\$80.85	
2	DXE-BEB-2 (insulated ele)					12.95	\$25.90	
2	DXE-HMS-1P (Beta match kit)					29.95	\$59.90	
8	DXE-SAD-075 (3/4" ele clmp)					4.5	\$36.00	
6	DXE-SAD-100 (1" ele clmp)					4.77	\$28.62	
2	DXE-BEB-2HWK (HWD kit)					5.95	\$11.90	
20	DXE-SAD-200A (2" saddle)					6.95	\$139.00	
1	DXE-BMP-2 (8x10x.25 boom plt)					21	\$21.00	
1	DXE-TCS-1 (Truss BKT)					23.5	\$23.50	
2	DXE-ATTB-2 (Truss/boom blk)					10.75	\$21.50	
36	3/16 770# Dacron rope	36 feet				0.2	\$7.20	
2	turnbuckles					4.95	\$9.90	
4	DXE-ECL-060 (SS Worm clmp)					1.4	\$5.60	
1	2oz Pentrox					2.95	\$2.95	
	Misc Rivets or screws/nuts (SS)					25	\$25.00	
						Total	\$818.62	

Word of Caution

If you are planning to use this antenna in a multi radio environment you may need coaxial band stubs or bandpass filters similar to ICE or equiv. on each feed line. Test interference at low power levels at first to determine filtering requirements. Make necessary stubs or install BPF units as required per your installation.

You may use this text to build your own antenna for non commercial applications. Author is not responsible for any damages. Installing antennas can be dangerous. Please use caution during installation due to inherent weight distribution on the boom may make the antenna tip. You must balance the weight to limit this effect. Please keep antenna away from power lines.

If you are not sure how to build or install this antenna safely, please have a professional assist you.

Thanks to Jim, K1IR for letting me design this antenna for his contest station. Element scaling was done on W6NL spreadsheet. Antenna was designed using MMANA and MMANA NEC2.

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