Antenna Airborne Research©

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Spec Review utilizes publicly available manufacturer's specifications ("spec") on the product, usually referred to as the "User Manual" or "User Guide." This can include photos and drawings of the product, a product description of the complete product, its components and connection materials. Many User Manuals also include tuning instructions accompanied with VSWR data, such as charts; however, it is important to know if the VSWR data is from a computer model, or actual testing utilizing reliable measurement devices. Tuning instructions sometimes can indicate if the product is simple or difficult to tune, the sensitivity to tuning settings to nearby objects and height above ground. User Manuals might also include instructions on how to match the particular product (antenna) to a recommended feed line, such as 50-ohm coax, plus placement of the feed line and additional suggestions for entry into a radio room (i.e. house).

A Spec Review includes comments on:

__The materials specified that are used to build the components;

__The ergonomics of the product ("user friendly")

__Installation suggestions for the product(s)

__Assembly/building instructions

__Specifications on efficiency, gain, pattern, power rating, environmental survival

__VSWR charts, tuning directions

__Warranty

Field Review is a hands-on assembly and testing of the physical antenna/product, with measurements using appropriate devices (i.e. VSWR meter, VNA) and power handling

Flight Review includes the above Field Review and adds actual field signal measurements using static signal sources and/or drones through the antenna pattern(s)

AMATEUR RADIO ANTENNA PRODUCT

SPEC REVIEW

using screenshots from the product User Guide

Comet – CHA-250HD

First Look

__The CHA-250HD is a single element vertical antenna and claims transmit coverage from 3.5 – 57 MHz and receive coverage from 2.0 – 90 MHz.

__Transmit power rating is 250watts (SSB) and 75 watts (Digital), although no duty cycle is specified.

__Survival is stated at 67mph and height of the vertical antenna is 24.7’

__The 50-ohm coax feed line (user supplied) screws onto the provided female UHF connector (SO-239).

__Stated, “no ground radials, no tuning or adjustments, and SWR under 1.6:1 from 3.5 MHz to 57 MHz. Plus, their wide bandwidth is not only good on ham bands but on shortwave bands as well.”

__The antenna type is given as, “Force matching type ground plane.”

__Price point, advertised at $429.99USD

Looking Deeper

__The low VSWR claim across a very wide frequency range causes concern, especially since there are no adjustments and no tuning. The height of the antenna is in-between a full size ¼ wavelength vertical for 40 or 20 meters. As such, the vertical is too tall for their 57MHz high end and much too short for the lowest frequency of 3.5MHz.

__There is no obvious device to match the antenna feed point to the feed line and the feed point will certainly vary across the stated frequency coverage range.

__There is no stated current return system, such as radials (wire or tubing), ground screen, or other type of counterpoise. This implies that the 24.7’ vertical is unbalanced.

__A first thought is that the vertical antenna is using the shield of the coax as the current return (some kind of untuned radial), or the shield is intended to be part of the radiating portion of the antenna.

__The vertical was originally all aluminum, but is now aluminum on the lower end, then a solid whip at the top. This is presumably stainless steel, which is a poor conductor / poor radiator.

__The base of the antenna that includes the coax connector has fins, which are unique, but are intended for some specific use. Usually, an enclosure that has fins is one that needs to dissipate heat. The fins provide increased surface area to dissipate the heat into the air.

__The obvious question is, “Why is there so much heat at the base of this antenna?” The object of an antenna is to radiate energy, not heat up a component. Some energy will be radiated from the 24.7’ vertical; however, the percentage of the radiated to the heat is unknown and should be cause for concern.

Detailed Spec Review of the User Guide

The CHA-250HD vertical portion is several sections. The prior model (the “250B”) used all aluminum sections on the vertical. It apparently was insufficiently strong in weather and was changed on this “250HD” model.

This new 250HD model replaces the top aluminum tubing with a solid steel whip.

The steel top whip is a poor conductor. This means that the efficiency of this model will be lower than the original 250B.

The base of this antenna is quite unique. It is a housing made of an insulating (non-conductive) material. It has short “fins” on the outside. There are also insulating pieces to keep the vertical from contacting the mounting frame. The frame is a typical formed piece of aluminum that is designed to be attached to a mounting tube with the supplied U-bolts, as shown in the parts picture above. The bottom of the finned insulating piece has a female UHF coaxial connector (i.e. SO-239) mounting that goes through the bottom of the mounting bracket. All of this looks like good workmanship and the components look like they all fit together in the

photos. The main question with this product is how it can maintain literally a flat VSWR across such a wide frequency range without any matching device and no tuning adjustment.

The published antenna type says this is a “Force matching type ground plane.” This is a unique description of an antenna design. Using a portion of the description, “ground plane” is a significantly different design, as a ground plane has usually a pair of horizontal wires or tubing elements to perform the current return function of the antenna. There are no components to perform this function.

Searching through more advertising on this antenna, the following was discovered on the DX Engineering website (product description is shown in italics):

*“**Comet CHA-250HD HF/VHF Vertical Antennas** is an updated design of the popular CHA-250B vertical antennas. These antennas make the most of a tight situation! When you have too little space or too much regulation, these antennas offer easy assembly and setup, no ground radials, no tuning or adjustments, and SWR under 1.6:1 from 3.5 MHz to 57 MHz! Plus, their wide bandwidth is not only good on ham bands but on shortwave bands as well, making these antennas perfect for an SWL wanting a low-profile, all-in-one antenna.*

*This improved **Comet CHA-250HD** features a new solid whip replacing the top aluminum section for greater flexibility and less strain on the lower sections in high winds. The “magic” behind the **CHA-250HD** is the transformer matching section. The transformer on the original CHA-250B had smooth sides. This improved design features a heat sink to dissipate the heat created inside the transformer from the RF that enters the power feeding section rather than transmitted as RF. This is the compromise needed to create a broad-band, low SWR, multi-band HF antenna with minimal visual impact.*

*When you are forced to play within the antenna and space restrictions of your QTH, **Comet CHA-250HD HF/VHF Vertical Antennas** can provide a clear winning advantage to getting out and making QSOs!”*

The second paragraph offers information on the actual antenna design and is highlighted in blue.

This highlighted section sheds light on our question regarding the new fins on the bottom enclosure. The “transformer matching section” is now described as having a heat sink. What does a heat sink do? In electronic circuits, there can be components that consume a substantial amount of power and, therefore, become hot. To avoid this heat from getting too high and damaging the component(s), a heat sink is installed, which can be an aluminum plate with rows of fins. The heat is conducted away from the component, into the plate and then to the fins, which expose the heat to the air and are cooled by air flow. In this antenna, the heat sink appears to be the enclosure with its new, added external fins. The question remains, as to where this heat is being generated.

An antenna is an electronic component to radiate (emit) RF (radio frequency) energy. It is normally designed for maximum efficiency so that as much of the energy ass possible is “sent” off into the air (technically, “the ether”). In this antenna design, however, the manufacturer’s expectation is that there will be a significant amount of heat at the antenna feed point and it needs to be dissipated to keep the antenna base (right at the feed point) from burning up. This is not good news for the customer, as the customer wants as much energy to be radiated off the vertical into the air and not dissipated in heat, which does not help in making contacts on the air. Basically, this design concept is the reverse of good antenna design; however, there is a possible reason behind this design choice. So, what is inside the finned base?

First, it is not metal, but some kind if composite material. The flat VSWR curve over a very wide frequency range is similar to a 50-ohm dummy load used to test a transmitter. These loads have a 50-ohm resister inside and the resistor absorbs the transmitted energy. They are rated at a power level and sometimes are inside an oil bath, or inside a housing that dissipates the heat. In all cases, if enough power is applied to a dummy load, it will burn up, or otherwise destroy itself. On the plus side, the dummy load provides a 1:1 VSWR across a wide frequency range. This antenna shows low VSWR curves similar to that of a dummy load – and – knowing that there are no vertical length adjustments, no adjustable impedance matching devices, no suggestions to add wire radials, or anything else, this antenna stands alone looking very much like a 50-ohm dummy load with a vertical antenna out the top.

The published VSWR curves do show curiosity. There are some dips in the published VSWR charts at various frequencies. How can this be? If one takes a dummy load, or other similar 50-ohm load, then add a vertical antenna to it, one will most likely see variations in the VSWR across a very wide frequency range. The attached vertical will be changing the 50-ohm load as the power supplied to it is changing frequency. This might show up as (small) variations in the VSWR.

The two pages of actual User Manual follow:

C★MET ANTENNA

MODEL CHA-250B

HF Broadband Ground Plane Antenna

Instruction Manual

Thank you for purchasing our products.

For your safety :
Read this manual carefully for proper handling and operation before using.
Keep this manual in a safe place for future reference.

★Check if all parts included in the box, according to the below Parts List.

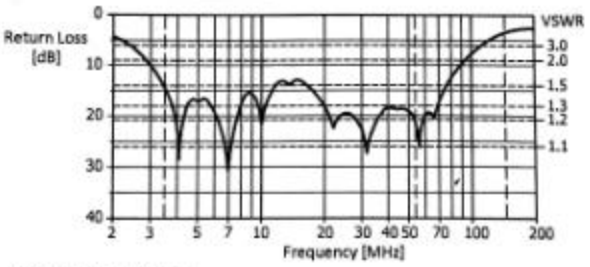
【Features】

- Non-radial and Ultra Wide-Band GP Antenna, and easy assembling.
- Thick base element and stainless bolts/nuts for heavy-duty opera on and weather-resistant.

【Specifications】

- Freq.Band : Tx / 3.5~57MHz, Rx / 2.0~90MHz
- Antenna Type : Force matching type Ground Plane
- Max Power : 250 W (SSB mode) , 75 W (Digital mode)
- VSWR : 1.5 or less (refer the below graph)
- Impedance : 50Ω
- Connector : SO-239 type
- Moun ng Mast Diameter : Φ30~72mm
- Max Wind Survival : 30m/sec
- Length : approx. 7.13m
- Weight : approx. 3.2kg

● Return Loss and VSWR Data



CHA-250B Parts List

	Parts List	Qty.
1	Feeding Section (Brackets and Pipe① included)	1set
2	Hose band (for mounting pipe①)	1
3	Radial Bracket w/t power feeding section	1
4	Pipe ② for inserting pipe ①	1
5	Pipe ③ for inserting pipe ②	1
6	Pipe ④ for inserting pipe ③	1
7	Pipe ⑤ for inserting pipe ④	1
8	U-Bolt with washer and hex nut M8	2sets
9	Hex Bolt M5x35(with metallic washer), wing nut	3sets
10	Hex Bolt M4x30(with metallic washer), wing nut	2sets
11	Self-fusing tape (20cm)	1
12	Guy wire ring (Plastic)	1

⚠ PRECAUTIONS for Installation

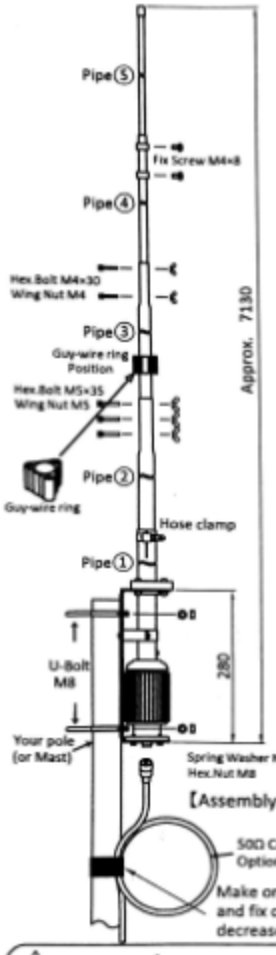
- Wearing a safety hat and a life line during installing on a roof top or any high places is highly recommended.
- Erect this antenna in a safe place

Check if the Cable Connector fits into the Antenna Connector.

- Make sure all nuts, bolts and screws are securely ghtened.

Failure to follow this would cause a serious accident or performance degradation.

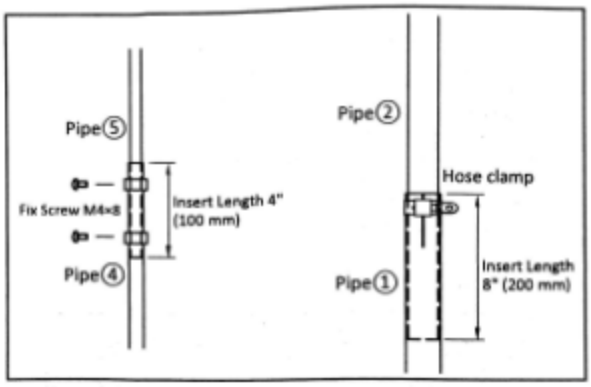
- Check if waterproofing at each connec on is appropriately done. If not, it would cause short-circuit and/or corrosion.
- Do not erect this antenna near any electrical power lines, steel towers and/or buildings. Such objects would cause performance degradation.



【Assembly drawing】

【How to Install & Use】

1. Pull the Pipe ② from Pipe ①, as shown in the left fig. At **200mm** inserted position, fix it with the hose clamp.
2. Fix the lower part of Pipe ③ with the hex bolt and the wing nut.
3. The ring for the guy-wire is installed in the element pipe③, and put the guy-wire by using it.
4. Pull the Pipe ⑤ at the top of the antenna. At **100mm** inserted position, fix it with the lock fitting screw.
5. Insert the Pipe ④ into the Pipe ③, and fix it with the hex bolt and the wing nut.
6. Attach the antenna to your pole with the U Bolt, Spring Washer, and Hex Bolt.
7. Connect your 50Ω Coax Cable(w/t PL-259 Connector) to Feeding Section SO-239, and waterproof it with the self-fusing tape etc.
8. Check if Antenna Resonance Point is SWR 1.5 or less.



★ Stretch the self-fusing tape two times longer and wrap it to the joint of connectors for waterproofing.

⚠Precautions for operation

- Do not touch the antenna while transmi ng, otherwise you would get burned.
- Do not touch the antenna or coax cables while lightning. Checking SWR a er lightning is highly recommended.
- Do not use this antenna outside its specifica on. Failure to follow this would damage the antenna.
- Make sure to adjust the antenna in a right way. Higher SWR could cause the performance degradation.
- Never a empt to fix or modify this antenna by yourself.

【After-Sales Service】

We provide the replacement parts for the damages by unintentional accidents or for deterioration with long-term use. Please ask the local shop you purchased this product. This product is made under the stringent quality control. Should there be any breakage in transit, please do not hesitate to contact the shop you purchased this product.

【Maintenance】

- If any unusual situation happens, stop using immediately and ask the local shop you purchased this product.
- Confirm if the product works normally before operating.
- Be sure to change the parts which have strength poverty or deformation across the ages etc.

■ Specifications or appearance is subject to change without notice.

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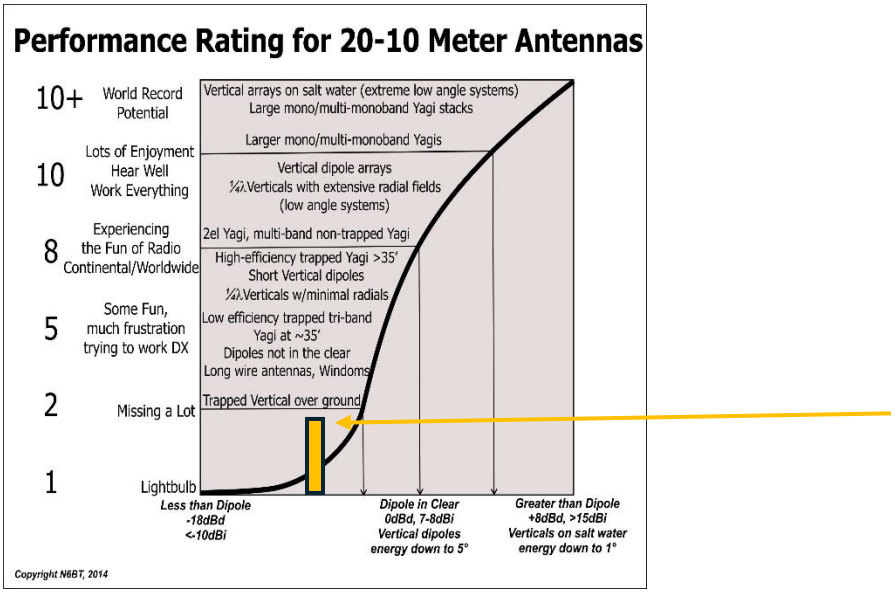
REVIEW CONCLUSIONS

Marketing focus: low VSWR across a very wide frequency range, no tuning

Overall impression: material looks good and simple assembly

Probable performance: possibly can make contacts, but with substantial loss. Contacts will be made because the other station has an efficient station and their station is making up the poor performance of this antenna. Best opportunities for contacts are on the higher bands, such as 15-12-10 meters. There is substantial loss on all amateur bands, with increased, major loss on the lower bands. This product would fit as shown on 15-10 meters, providing about a level 1.5-2 of enjoyment of radio:



On the lower bands, the performance will be substantially lower, almost impossible except under exceptional conditions, such as the other station is within a few miles.

Ways to improve this product:

__use the vertical for a good design and do not use the feed system and its housing

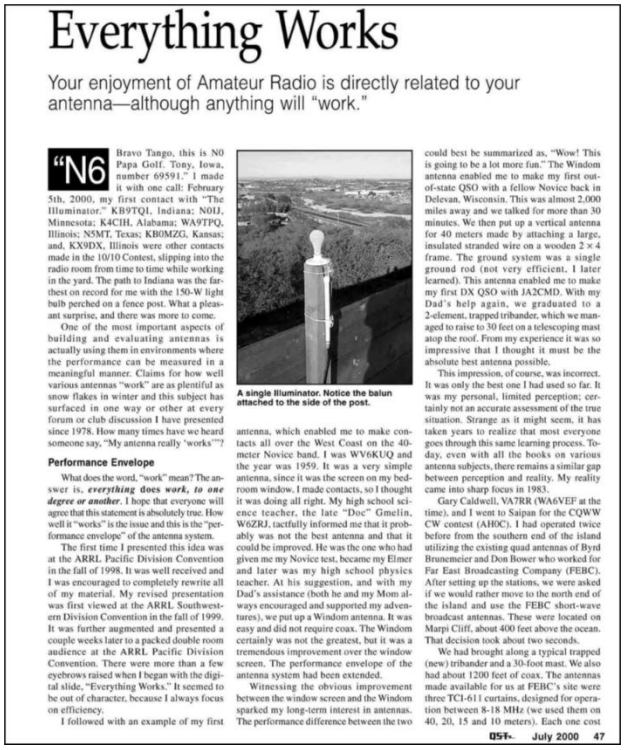
__re-using the tubing is financially a poor decision, as 25' of tubing can be purchased for a lot less than the $430 retail price of this antenna.

…end

Remember: Everything Works – the key is, "Compared to what?"

This lightbulb was used in the A.R.R.L. International DX Contest with 120 watts; worked 28 countries and all continents.

The write-up is found back in QST, July, 2000



Everything Works

Your enjoyment of Amateur Radio is directly related to your antenna—although anything will "work."

"N6 Bravo Tango, this is N0 Papa Golf. Tony, Iowa, number 69591." I made it with one call: February 5th, 2000, my first contact with "The Illuminator." KB9TQI, Indiana; N0IJ, Minnesota; K4CIH, Alabama; WA9TPQ, Illinois; N5MT, Texas; KB0MZG, Kansas; and, KX9DX, Illinois were other contacts made in the 10/10 Contest, slipping into the radio room from time to time while working in the yard. The path to Indiana was the farthest on record for me with the 150-W light bulb perched on a fence post. What a pleasant surprise, and there was more to come.

One of the most important aspects of building and evaluating antennas is actually using them in environments where the performance can be measured in a meaningful manner. Claims for how well various antennas "work" are as plentiful as snow flakes in winter and this subject has surfaced in one way or other at every forum or club discussion I have presented since 1978. How many times have we heard someone say, "My antenna really 'works'"?

Performance Envelope

What does the word, "work" mean? The answer is, ***everything does work, to one degree or another***. I hope that everyone will agree that this statement is absolutely true. How well it "works" is the issue and this is the "performance envelope" of the antenna system.

The first time I presented this idea was at the ARRL Pacific Division Convention in the fall of 1998. It was well received and I was encouraged to completely rewrite all of my material. My revised presentation was first viewed at the ARRL Southwestern Division Convention in the fall of 1999. It was further augmented and presented a couple weeks later to a packed double room audience at the ARRL Pacific Division Convention. There were more than a few eyebrows raised when I began with the digital slide, "Everything Works." It seemed to be out of character, because I always focus on efficiency.

I followed with an example of my first antenna, which enabled me to make contacts all over the West Coast on the 40-meter Novice band. I was WV6KUQ and the year was 1959. It was a very simple antenna, since it was the screen on my bedroom window. I made contacts, so I thought it was doing all right. My high school science teacher, the late "Doc" Gmelin, W6ZRJ, tactfully informed me that it probably was not the best antenna and that it could be improved. He was the one who had given me my Novice test, became my Elmer and later was my high school physics teacher. At his suggestion, and with my Dad's assistance (both he and my Mom always encouraged and supported my adventures), we put up a Windom antenna. It was easy and did not require coax. The Windom certainly was not the greatest, but it was a tremendous improvement over the window screen. The performance envelope of the antenna system had been extended.

A single Illuminator. Notice the balun attached to the side of the post.

Witnessing the obvious improvement between the window screen and the Windom sparked my long-term interest in antennas. The performance difference between the two could best be summarized as, "Wow! This is going to be a lot more fun." The Windom antenna enabled me to make my first out-of-state QSO with a fellow Novice back in Delevan, Wisconsin. This was almost 2,000 miles away and we talked for more than 30 minutes. We then put up a vertical antenna for 40 meters made by attaching a large, insulated stranded wire on a wooden 2 × 4 frame. The ground system was a single ground rod (not very efficient, I later learned). This antenna enabled me to make my first DX QSO with JA2CMD. With my Dad's help again, we graduated to a 2-element, trapped tribander, which we managed to raise to 30 feet on a telescoping mast atop the roof. From my experience it was so impressive that I thought it must be the absolute best antenna possible.

This impression, of course, was incorrect. It was only the best one I had used so far. It was my personal, limited perception; certainly not an accurate assessment of the true situation. Strange as it might seem, it has taken years to realize that most everyone goes through this same learning process. Today, even with all the books on various antenna subjects, there remains a similar gap between perception and reality. My reality came into sharp focus in 1983.

Gary Caldwell, VA7RR (WA6VEF at the time), and I went to Saipan for the CQWW CW contest (AH0C). I had operated twice before from the southern end of the island utilizing the existing quad antennas of Byrd Brunemeier and Don Bower who worked for Far East Broadcasting Company (FEBC). After setting up the stations, we were asked if we would rather move to the north end of the island and use the FEBC short-wave broadcast antennas. These were located on Marpi Cliff, about 400 feet above the ocean. That decision took about two seconds.

We had brought along a typical trapped (new) tribander and a 30-foot mast. We also had about 1200 feet of coax. The antennas made available for us at FEBC's site were three TCI-611 curtains, designed for operation between 8-18 MHz (we used them on 40, 20, 15 and 10 meters). Each one cost

NOTE: All those 28 countries were worked because the other station had a far better antenna system – it made up the difference of the very poor lightbulb "antenna."